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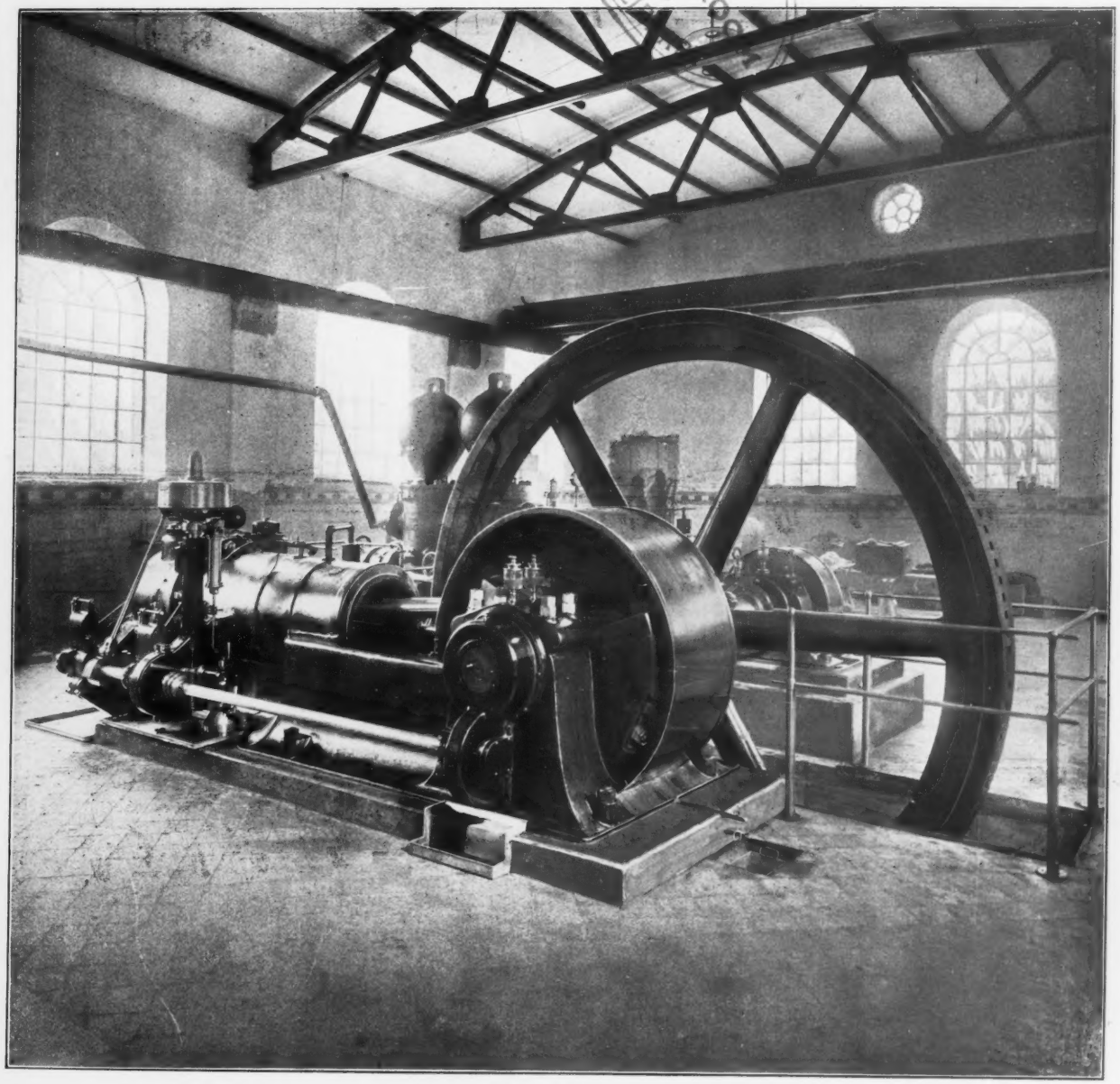

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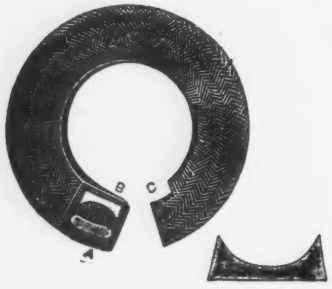

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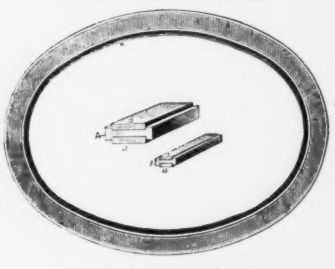

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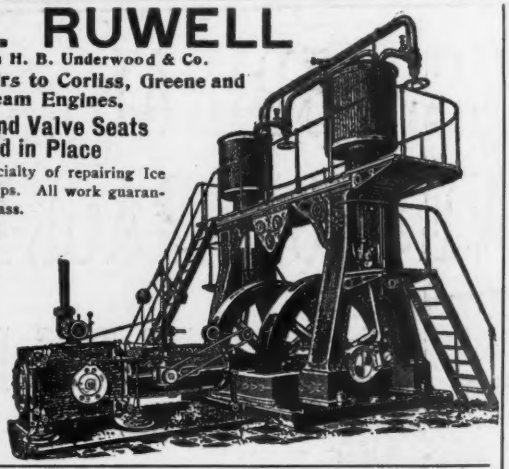

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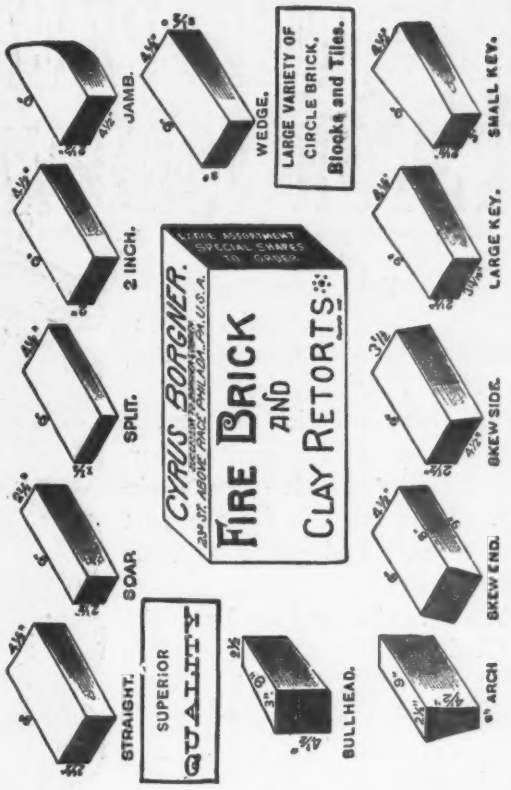

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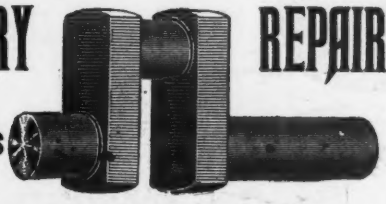

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VOL. VIII PHILADELPHIA, FEBRUARY, 1904 No. 1

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A Modern German High-power Gas Engine Manufacturing Plant.

The Koerting Gas Engine as Applied in this Country and Europe.

By FRANK C. PERKINS.

The high power gas engine is now being extensively used in Europe for driving electrical generators of both direct and alternating current systems in large iron and steel plants as well as in central power stations. Until very recently the largest gas engine installations, as well as the largest gas engines manufactured were to be found in Europe, but at the present time one of the largest, if not the largest gas engine plants in the world, is being installed at Buffalo, N. Y., by the Lackawanna Steel Co. These high power gas engines will have a total capacity of 40,000 h.p. Sixteen of these engines will each have an output of 2000 h.p. giving a total capacity of 32,000 h.p., while eight units of 1000 h.p. each have already been installed, or are about completed. While these engines are to be built in this country by the DeLaVergne Refrigerating Machine Co., of New York, still the engines are of German design, as constructed at Koertingsdorf near Hanover, at the works of Gebr. Koerting. The accompanying illustration, Fig. 1, shows the immense erecting hall of the works of the Gebr. Koerting Aktiengesellschaft. The large twin engine in the foreground is of the double acting type, having a capacity of 1000 h.p. It will be noted from this illustration that there are provided a number of small cranes of the overhead traveling type, each having a capacity of 10,000 pounds. These are used in erecting the engines for handling the smaller parts, while a large overhead traveling crane electrically operated is provided above the smaller cranes for handling the fly wheels and other large castings used in the construction of the high power gas engines. The illustration, Fig. 2, shows a simple and neat design of gas engine of 100 h.p. capacity constructed at the Koerting works, while the illustrations Figs. 3 and 4 show a number of large engines constructed at this plant for various purposes. The gas engine is a most economical prime mover competing successfully with steam engines of the multi-cylinder type of the highest efficiency. The gas engine of high power as employed at modern iron and steel plants in Germany and other European countries is utilizing the waste blast furnace gases in a most successful manner. They are being employed for driving pumps, as well as large blowing engines and electrical generators. The accompanying illustration, on the cover of this issue, shows two 90 h.p. Koerting gas engines driving pumps at the Luxemburg Water Works, in Germany; while Fig. 3 shows a 500 h.p. double acting Koerting blowing gas engine as installed at the power house at Duisburg, Germany.

This 500 h.p. engine operates at a speed of 100 revolutions per minute and weighs without the fly wheel 120,000 pounds, and with the fly-wheel 150,000 pounds. The working cylinder has a diameter of 25 inches, while the stroke of the engine measures 3½ feet. At this plant the blowing cylinder is mounted at the end of the gas engine but in the case of the blowing engine for the Lackawanna Steel Plant, the construction is somewhat different. Of the 16 2000 h. p. blowing gas engines at Stony Point, Buffalo, eight units will be installed in one power house and the remaining eight of 16,000 h. p. capacity in the other. These engines are of the vertical-horizontal type the air cylinders being arranged as the vertical element and the gas engine cylinders as the horizontal element. These engines will operate at a speed of 80 revolutions per minute, the stroke being 5 feet. The air cylinders are 6′4″ in diameter, while the gas engine power cylinders are 3 feet 2½ inches in diameter. The gas pump cylinders are a trifle under 4′ in diameter and the air pump cylinders are somewhat over 3′ in diameter. These gas engines are double-acting, like a steam engine and therefore the crank end and the head end of the power cylinder K, as noted in diagram of Fig. 5 are similar, the admission valves being located in the valve boxes, which are bolted to the cylinder head. As the products of combustion escape through the slots or ports cast in the middle of the cylinder from where the exhaust pipe leads, no exhaust valves are required. The slots are covered by the motor piston itself and for this purpose it is made very long, and is packed at each end by self-closing spring rings. Two double-acting auxiliary pumps, one for the gas, G. P. Fig. 5, and one for the air, L. P., are provided, by which the combustible mixture is admitted to the working cylinder K. In designing these pumps they are so proportioned that their

combined action also secures the proper mixture for perfect combustion. The compression spaces of the pumps are divided so that the crank ends of the air pump and the gas pump discharge into the crank end of the power cylinder K. The head ends of the pumps G. P. and L. P. also discharge into the head end of the power cylinder; the gas and air being compressed by the pumps to about nine pounds per square inch. It will be noted from the diagram, Fig. 6, that the piston is at the outer dead point and the exhaust ports are exposed toward the opposite or head end of the cylinder. The instant the cylinder begins to uncover the exhaust ports, the pressure of the residual products of combustion in the cylinder falls to that of the atmosphere. As soon as this takes place the inlet valve is opened and a fresh charge is forced into the cylinder by the pumps. The valve gear of the pumps and working cylinder is so arranged that air only is supplied first, to separate the burned gases from the fresh mixture and afterwards, the air and gas mix in proper proportion. The mixture of air and gas is produced only at the inlet to the cylinder, there being no storing of it, thus representing an advantage, it is claimed, over engines that keep more or less of the combustible mixture outside of the working cylinder. As soon as the exhaust ports are covered by the receding piston, the air and gas pump pistons L. P. and G. P. also arrive at their dead point position and the supply of mixture is interrupted. The inlet valve closes and the charge is compressed in the cylinder till at the dead point of the stroke, ignition takes place. At the next movement of the main piston, the ignited charge exerts its driving power by expanding till just before arriving at the other dead point, when the piston uncovers the exhaust ports again and allows the consumed charge to be blown, while on the opposite end of the piston, the same operation takes place.

The accompanying illustration, Fig. 4, shows two of these 500 h.p. Koerting double-acting gas engines driving alternators

Fig. 1. Erecting Shops of Koerting Engine Co., near Hanover, Germany. 1000 H. P. Double Acting Gas Engine in the Foreground.

built by the Allgemeine Elektricidats-Actien-Gesellchaft at the power house of the iron and steel plant at Oberhausen, Germany. These gas engines are operated by the waste gases from the blast furnaces, and the current generated by the alternators is transmitted about the works for lighting and power purposes. The 8-1000 h.p. gas engines at the power house No. 1 of the Lackawanna Steel Company are similar in construction to these engines shown in Fig. 5, but are double, one engine of 500 h.p. being installed on either side of the electrical generator, which gives a total output of 1000 h.p. The power house is over 700 feet in length and contains not only the eight 1000 h.p. engines, driving the electrical generators, but also a number of blowing engines, pumps, compressors and steam engines.

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The eight horizontal duplex two-cycle Koerting double-acting gas engines are each directly connected to a 500 kilowatt electrical generator. Three of the dynamos are of the Sprague direct current type supplying a continuous current of 250 volts

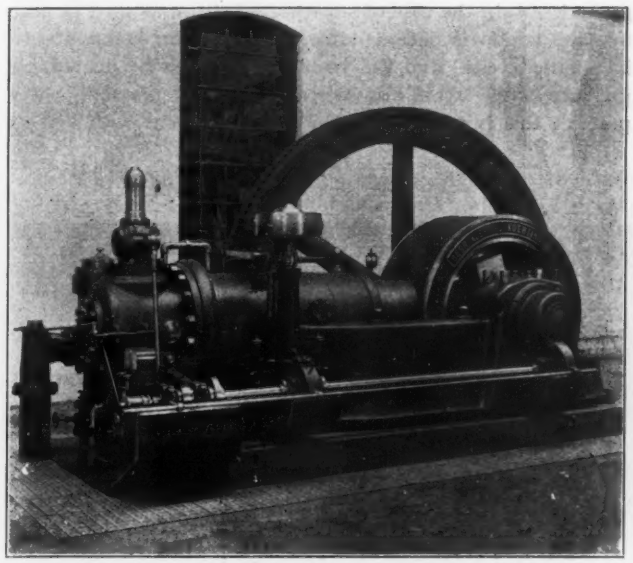

Fig. 2. 100 H. P. Koerting Gas Engine.

pressure, while the remaining 5 dynamos are three-phase 25 cycle alternators of the general electric type supplying a poly-phase current at a pressure of 440 volts. Each of these engines operates at a speed of 100 revolutions per minute, the cylinders having a diameter of about 2 feet and a stroke of about 3½ feet. The engines as above mentioned are controlled by piston valves, the air and gas pumps being driven by an eccentric gear from the main shaft. The regulation of power is effected in the following manner: When the load on the engine is reduced, the gas pump begins to furnish gas at a correspondingly later period, thus discharging a dimished quantity of gas into the working cylinder. This is accomplished either by the valve gear of the pump and controlled by the governor or by a by-pass located between each pump and respective compression channels which lead to the inlet valve on the main cylinder. The throttling device in this by-pass is also under the control of the governor. It will thus be noted that the engine operates with a variable amount of mixture and that correspondingly more or less air is sent first into the power cylinder. This air stays near the middle of the cylinder, while a combustible mixture remains at the heads of the cylinder near the inlet valve and igniters. It is stated that the peculiar shape of the cylinder heads prevents mingling of the layer of air with the following mixture of gas and air. For ignition of Koerting engines there are provided two spark coils at the end of the power cylinder. These are operated by a separate shaft driven by spur-gearing from the cam shaft. The gear on the igniter shaft is not fast, being connected with a sleeve having a feather which is set spirally around the shaft so that by a sliding movement of the wheel, the igniter shaft may be set behind or in advance of the cam-shaft. In this way the time of ignition can be changed during the running of an engine so as to suit whatever kind of gas is being delivered and at starting, the point of ignition may be so set that ignition takes place only after the piston has passed the dead point and the engine is thus started very slowly without incurring any pre-ignition. Compressed air is used for starting the engine, a pressure of 150 pounds per square inch being used for the blowing gas engines and about 100 lbs. per square inch for gas engines driving electrical generators. For admitting the compressed air at the front and back ends of the cylinder, a piston valve is provided as in a slide-valve steam engine, and this is operated from the camshaft by an eccentric which can be thrown in or out of gear by a clutch. The engines usually start off very readily after filling the cylinder with air twice. The power cylinder and the piston are cooled by circulating water, as well as the heads and valves. In the case of the piston the water enters the tube carried through the cross head pin and hollow piston rod and returns the same way, but on the outside of the tube. The cylinder walls are cooled throughout except at the middle, where the exhaust slots are located, and the stuffing boxes in the cylinder heads are also surrounded by water. Westinghouse induction motors are directly connected to centrifugal pumps which supply the necessary cooling water. The gas used by the engines is supplied by a three foot pipe connecting with the blast furnace through a centrifugal washer which purifies and removes the dust from the waste blast furnace gas. An electric motor is used for driving a fan and a water spray, used in connection with the air blast, causes the dust and impurities to be removed from the gas. In addition to the gas used in these engines a large quantity is burned under the boilers for supplying steam to the various engines about the plant, and also is burned under the furnace stoves for heating the blast. The Koerting engines operated by the blast furnace gas occupy about one-half of the power house No. 1 at the Lackawanna Steel Plant, and the current generated by the alternators and direct current machines is used for lighting the steel plant throughout with arc and incandescent lamps and also for driving a large number of cranes and other machines about the works. Several hundred motors are employed in

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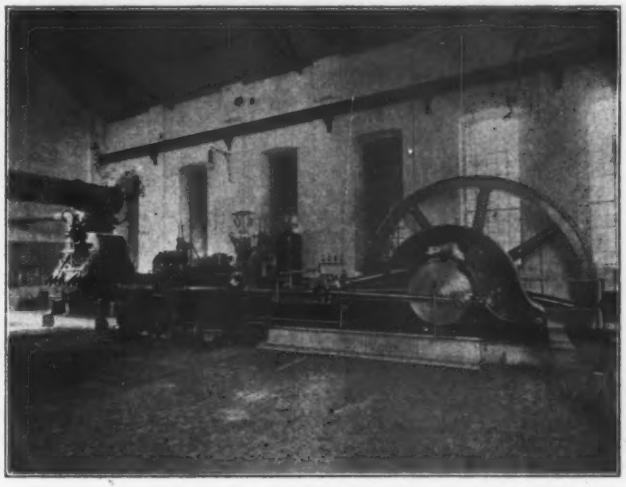


Fig. 3. 500 H. P. Double Acting Koerting Blowing Engine.

the various shops, rail mills, boiler houses, billet mills and about the blast furnaces and ore docks and a reserve steam engine driven electric generating plant is also provided at these works.

There is no question but that the high power gas engine has a wonderful future before it, particularly in connection with the

use of waste blast furnace gases. The thermal efficiency of this gas engine is said to have been experimentally determined by Prof. E. Meyers, to be 38%. This is very much higher than the thermal efficiency of a triple expansion high power steam engine, which hardly exceeds 25%. There is every reason to believe that the 40,000 h.p. gas engine plant now being installed in this country will in every way meet the expectations of the designing engineers as these German engines have given most excellent satisfaction in the power house of the iron and steel plants in Europe.

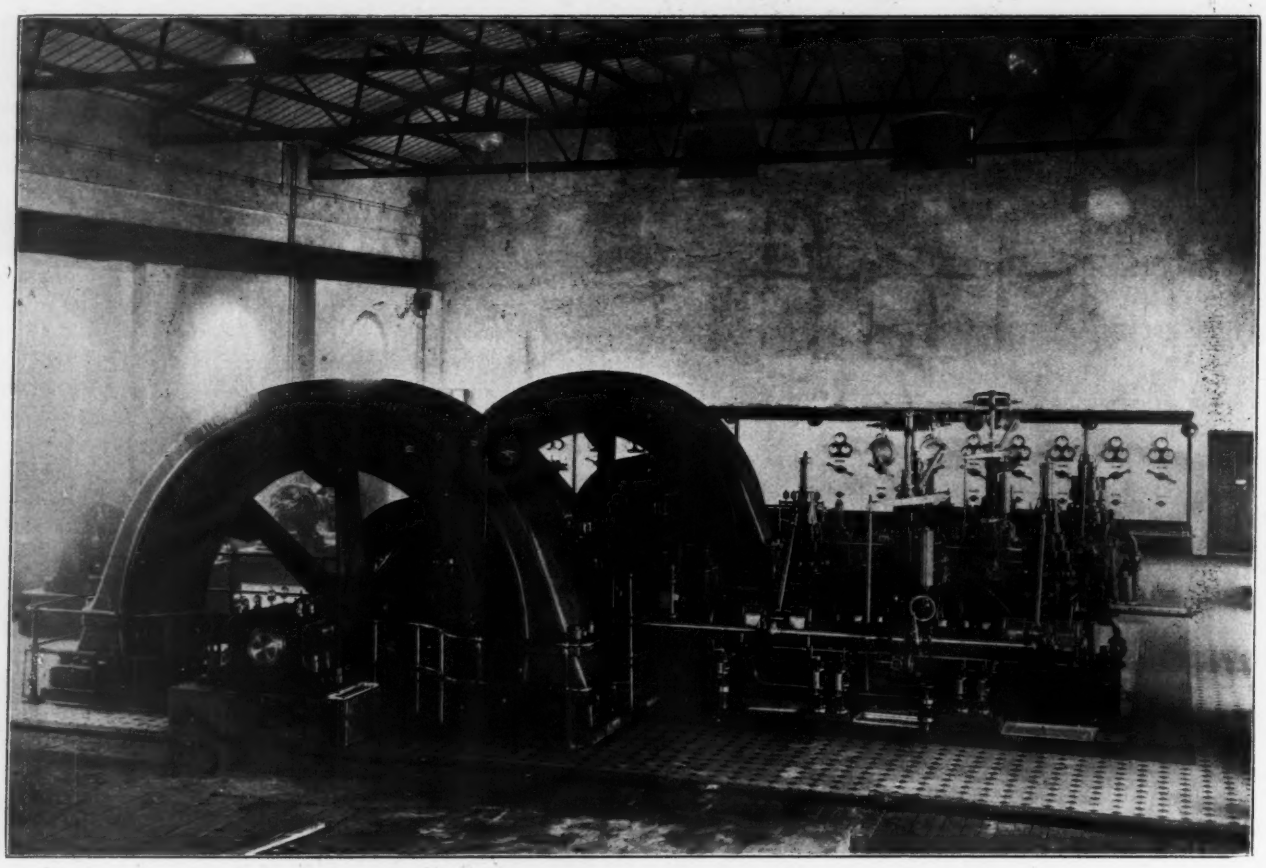


Fig 4. Two 500 H. P. Koerting Gas Engines Driving Alternators at the Iron and Steel Plant at Oberhausen, Germany.

Saturated and Superheated Steam.

The chief characteristic of saturated steam is that it is always at a critical point at which, where heat is abstracted from it and its temperature lowered, part of the steam will at once condense. When saturated steam enters the steam engine and strikes the cool walls of the cylinder, the steam is cooled somewhat, the temperature of the steam is lowered and part of the steam condenses forming water at the same temperature as the steam.

To raise the temperature of saturated steam it is necessary to have the steam in contact with the water, and then to heat the water. The effect of this is to generate more steam, which if it cannot escape will raise the pressure of the steam, and with the increase in pressure will come the increase in temperature. If the steam itself were heated, instead of the water, superheated steam would result.

It should be clearly understood that when the temperature of saturated steam rises, the pressure of the steam always increases, and when the temperature is lowered, the pressure grows less. In the case of superheated steam as used in practice the action is entirely different. If steam were contained in a closed vessel and the vessel should then be heated, the pressure of the steam also increases with the pressure, but in practice this is not usually the conditions met with. When steam is superheated for use in a steam engine, the steam space of the superheater is always so connected with the boiler and the engine piping that as the temperature of the steam increases the volume increases instead of the pressure, and the superheating is said to be done at a constant pressure. Under these conditions the amount of heat necessary to raise a pound of steam one degree is 0.48 of a heat unit. This value 0.48 is called the specific heat of steam. If it is required to raise a pound of steam 40 degrees, we will say, it will require $40 \times 0.48 = 19.2$ heat units.

The theoretical efficiency of the steam engine depends upon the temperature of the live steam and the temperature at which it is exhausted, so that the greater this difference, the greater we might expect the efficiency of the engine to become. This

would be true in practice if it were not for cylinder condensation, although it more nearly approaches the theoretical result at high pressures than at low ones.

The chief difficulties of its use in practice is its high temperature. If the steam is heated to a sufficient temperature to prevent initial condensation, the temperature must be very high, especially with steam at high pressures. For instance, with steam at 90 pounds pressure, the corresponding temperature is 320 degrees. With a moderate degree of initial condensation, it is estimated that the steam would have to be raised to a temperature of about 600 degrees to be entirely effective.

Such a high temperature as this is unsuited for use in steam engines, as it tends to burn up and harden all the lubricants, destroy the packing in the stuffing boxes, and exercise a corrosive effect upon brass and copper with which it comes in contact.

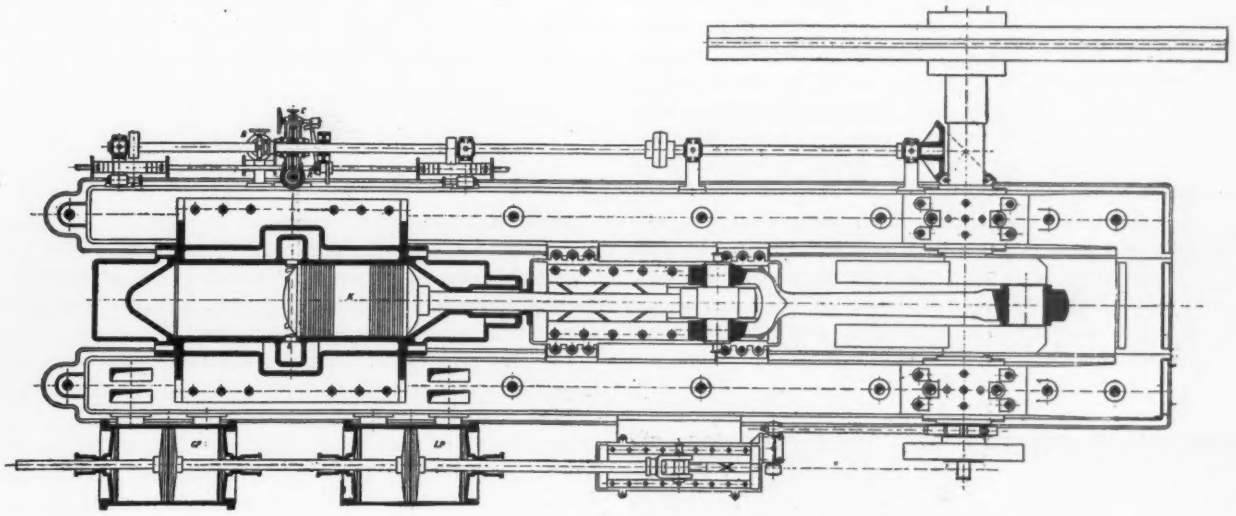


Fig. 5.
Plan of Koerting Double Acting Engine.

It is said in practice that whenever the steam reaches a higher temperature than about 500 degrees, injury to the engine cylinder and its parts invariably follows, so that high pressure steam cannot be sufficiently heated to entirely clear initial condensation. With steam at a low pressure, the difference between the temperature of the admission and exhaust will not be so great. The initial condensation would then not be so great and, therefore, the amount the steam must be superheated will fall within a safe range of temperature.

When the boilers are given to priming, a moderate amount of superheat may be of an advantage so as to insure its being thoroughly dry before it enters the cylinder.

Progress in Wireless Telegraphy.

The use of wireless telegraphy appears to be making rapid progress all over the world. It is announced that the work on a Marconi tower and equipment at Pisa, Italy, has been commenced, and it is hoped that wireless communication will be established with Argentine Republic, and later with the United States. Wireless stations are also being established at Dieppe, France, and Newhaven, England, and a regular service maintained across the English Channel. Wireless communication has been established between Japan and Formosa, and is said to be working satisfactory.

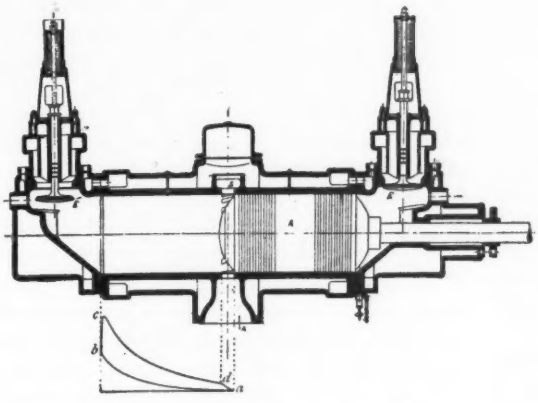


Fig. 6.

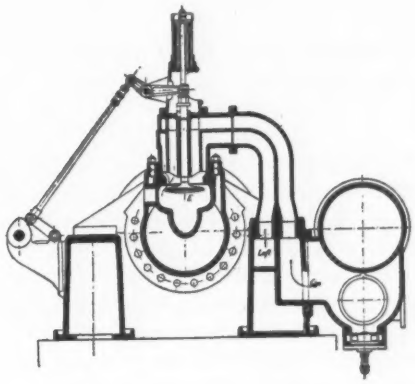
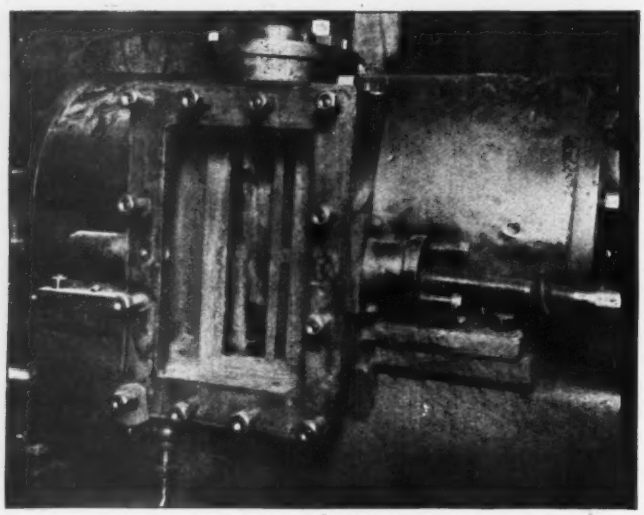


Fig. 7.

Sectional Details of Koerting Double Acting Engine.

A Curious Break in the Valve Chest of a Slide-Valve Engine.

The accompanying illustration shows a curious break which occured in one of the bridge walls of a D-slide-valve engine. The engine is a slow speed one of the horizontal type with throttling governor and a fixed cut-off. It had been in use for many years to run the very varying load of a saw and planing mill. Fortunately, the break was discovered by chance, before it did any damage. The engineer in charge noticed that whenever a heavy load was thrown on the engine, it showed a disposition to stop, or, as he put it, "She seems to have the consumption and coughed." When the valve cover was removed and the valve taken out, the piece of bridge wall that was broken was not entirely broken off from the cylinder, but was still attached at one small place, the crack in some places being so wide that a finger could be put through it. Upon examination, the break appeared to be an old one, and the remarkable part of it was that the loose piece held in its place and did not



Valve Chest of D-Slide Valve Engine showing Broken Bridge Wall.

break off entirely, which, if it had, would have meant that the engine, in some part, would have been demolished.

There are several reasons advanced why a crack of that kind should take place; for instance, a flaw in the cast-iron, unequal contraction or expansion, or some obstruction entering the valve chest with the steam. If there was a flaw in the cast-iron, it seems strange that it did not appear before this time, as the engine has been running a long number of years. Unequal expansion of the cylinder and bridge walls could explain this crack, as in some parts of the crack the edge seem to have been worn smooth by the rush of steam through it and the oil in the steam seemed to have deposited itself for a long time in the depressions. One of the most usual causes of an accident of that kind is an obstruction in the valve chamber. This could happen if a broken piston ring was used. A piece of this ring might fall in the cylinder and on account of the clearance of the engine do no damage, but when the exhaust is opened it is likely to be sucked out with the steam. If the valve started to close at the time this piece was entering the valve chest to be exhausted, the piece of ring would be caught between the inside of the valve and the bridge wall and thus cause the crack, the loose piece being not too large to cause the cracked piece to snap off, but large enough probably to crack it, and the spring in the loosened part of the bridge wall would be enough to allow the obstruction to get by and be exhausted through the exhaust port. It is needless to say that the engine in its present shape is useless, and as the repairs to it would be costly, it will be replaced by a modern slow-speed engine.

A New Use for Aluminium

Aluminium has a new field of usefulness. To this the attention is just now directed by Dr. Hans Goldschmidt, whose lecture at Columbia University revealed new possibilities for the metal, which, according to chemists, is more abundant than any other in the earth's crust.

The key to the function which aluminium performs in metallurgy and engineering is found in the remarkable heat that is suddenly developed when it is burned. Combustion, it will be remembered, is simply the union of a given element with oxygen. When wood or coal is set on fire the carbon combines with that gas and produces carbonic oxide. Aluminium will not unite with atmospheric oxygen, though. It is necessary to supply the element in a solid form. The oxide of some other metal furnishes this. If equal parts of aluminium and the oxide of iron, both pulverized and cold, are placed in a crucible, and a tiny fuse of the right kind is applied, a marvelous effect is produced. The receptacle becomes a furnace. By purely chemical means a temperature is induced that rivals that of the electric arc. Within a minute or two the aluminium steals the oxygen from the iron, and the latter is melted. If, in advance and with a view to further operations, the iron is charged with the proper amount of carbon or some other element, the product is a steel possessing qualities that adapt it to some special services.

One highly practical operation made feasible by the process here described is the welding of rails on trolley roads. In order to employ both the main track and the third rail (if there be one) as electrical conductors it is customary to do one of two things. Either a copper bond is attached to the ends of adjacent rails at each joint, or a little molten iron is poured around the steel there. The latter operation, as formerly conducted, involved the use of cumbrous and expensive apparatus. In Europe aluminium is now used to some extent instead. A small portable crucible, tapering to a point, is adjusted over the right spot, a mould is then formed around the joint to be welded, the proper mixture is ignited and almost immediately a supply of liquid steel is ready to be run into place. So intense is the heat of the latter that it dissolves part of the metal of which the rail is composed, and a joint of surprising strength is created. Here again aluminium figures as a rival of copper, and it promises to make the old style bond unnecessary.

When one has grasped the simplicity and effectiveness of the new process, as applied to electric railways, he will be quick to see how helpful it can be in repairing great castings or forgings like the sternpost or crankshaft of an ocean steamship. It will often happen that work of this kind can be performed at sea; but, even if it is delayed until the end of the voyage, the necessity for going into a dry dock and a resort to the services of a forge can usually be avoided.

The Regulation of Steam Engines.

Method of Speed Control. Cut-off and Throttling Engines.

PART I.

A division of the steam engine into classes, which possesses both interest and importance, is based upon the method of control with respect to the energy it shall deliver, when the outside work or resistance varies within wide limits.

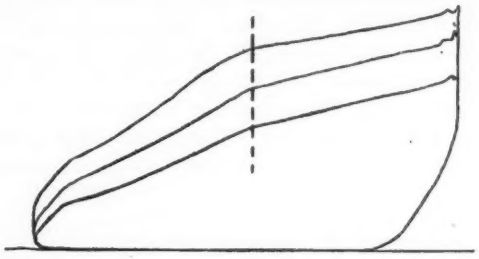


Fig. 1.

We know that the formula

$$\text{H. P.} = \frac{\text{PLAN}}{33{,}000}$$

is the usual one for calculating the work done by an engine. For any given engine the length of stroke and area of piston are constant; and the only two factors that can change, when the work upon the engine varies, are the mean effective pressure, P, and the number of strokes N. In almost all engines of the present day, it is important that the number of strokes remain constant, so that the only factor in the formula that can vary, when the work varies, is the mean effective pressure.

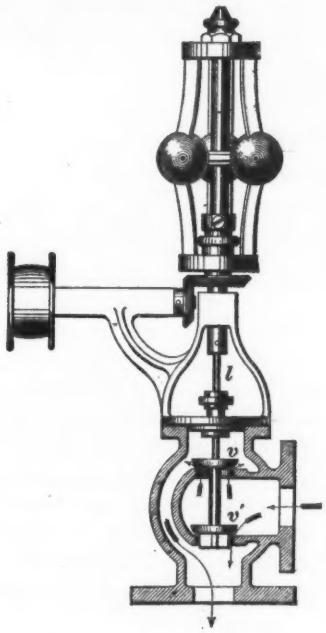


Fig. 2.

This is done in two ways; first, by changing the point of cut-off, and second, by keeping the cut-off constant, and changing the initial pressure. This divides the engines into two classes, cut-off engines and throttling engines.

In the throttling engine, the cut-off remains constant, so that the initial pressure must be increased or reduced as the work upon the engine is increased or reduced. As the boiler pressure remains constant, the initial pressure in the cylinder of the engine is changed. When steam of a given pressure flows into a large chamber through a small orifice, it expands and its pressure is reduced. It is said to be choked or throttled. If by any means this opening can be made larger or smaller, this pressure in the chamber becomes larger or smaller. When applied to a steam engine, the effect of this is to decrease the height of the indicator card and diminish the horse power. The mechanism which governs this opening is called a throttling governor. Fig. 1 shows the effect of opening and closing the throttle valve upon the indicator diagram, the dotted line representing the fixed point of cut-off.

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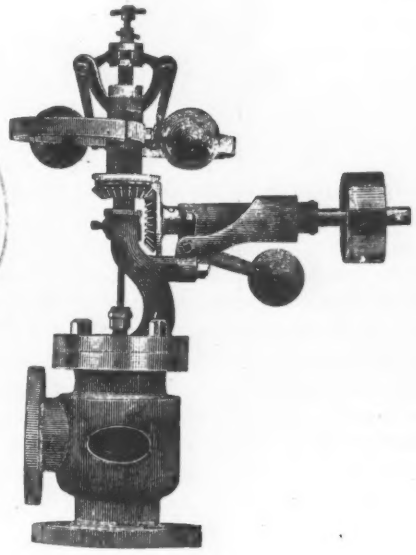

Fig. 3.

The ordinary throttling governor showing a section through the valve is shown in Fig. 2. There are three balls and they move outward against the resistance of gravity and of the three flat springs. In so doing they lower the valves V and V′ and thus partially shut off the steam supply and throttle it. If the engine moves faster than the desired speed, the fly balls are forced to revolve at a higher speed, and will consequently move outwards and upwards through the action of centrifugal force. The action forces the spindle *l* downwards and partly closes the throttle valve. The engine thus takes less steam and the speed falls to the desired point, the governor balls in the meantime returning to their original position. Should the resistance become greater than the power of the engine, it slows up slightly, the balls drop and open the valve wide. More steam is admitted and the engine immediately regains its original speed. The steam in passing through the valve is said to be wire drawn. The term wire drawn is applied to

any case in which the steam pressure is reduced owing to insufficiency of valve opening. This governor is known as the Pickering Governor.

Fig. 4.

Fig. 3 represents the Waters Governor, which works on the same principle.

Fig. 4 represents the Shive Governor, in which advantage is taken of the inertia of the balls by hanging them to one side of the spindle, and Fig. 5 represents the Gardener throttling governor, which uses a counterweight to regulate the speed to any requirement.

A governor which has been designed with a view of improving upon the present ball governor is known as the Kuhlewind momentum governor. A sectional view of this governor is

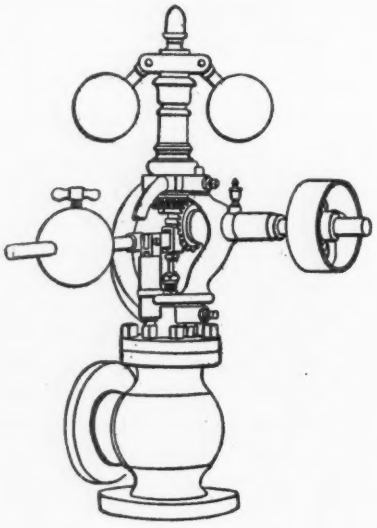

Fig. 5.

shown in Fig. 6. It consists of a rotating wheel which by means of ball bearings rests upon a stationary casing that is bolted to the valve box. Through the center of the wheel goes a long spindle, which forms the neck of the operating gear of the governor. This spindle neck is fastened in a circular cross head, and in the latter are four wedge shoes, two of which are connected with the valve and two are idlers. There are two balls connected to the governor, which, however, do not operate upon the valve as the balls in the ordinary ball governor. They are attached to the fly-wheel of the governor by means of stems, and at the opposite end of these stems are connected two brake shoes.

When the engine is running there is momentary variation in the relative speeds of the engine and the wheel of the governor due to the weight of this wheel. This momentary variation causes a raising or lowering of the wedge shoes, which are connected by means of the lifting cross-head with the main valve. The effect of this movement of the wedge shoes keeps the engine at a normal speed. This action of the wedge shoes is controlled by the pressure the brake shoes of the balls exert

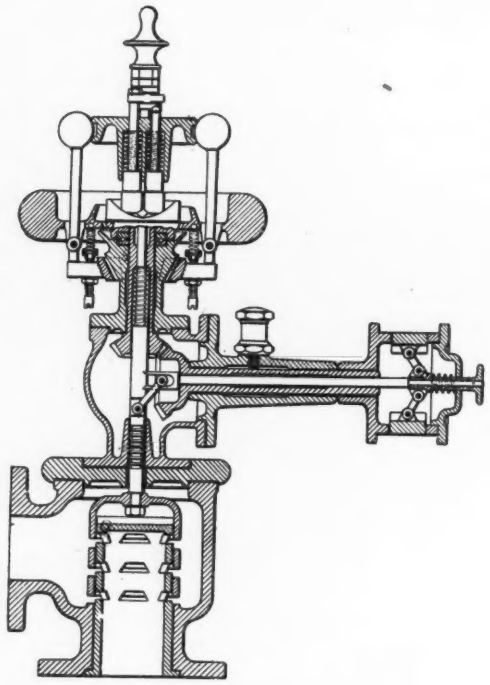

Fig. 6.

upon the brake ring. This type of governor is said to be particularly adapted for rolling mill engines, the load upon which varies from zero to maximum almost constantly.

In the cut-off type of engine the area of the indicator diagram is diminished by diminishing the portion of the stroke during which steam enters the cylinder. This is usually done automatically by a governor, and such engines are usually called automatic cut-off engines. The effect on the indicator diagram is shown in Fig. 7.

The automatic cut-off engine is regulated by a governor, which is of one of two types, the pendulum or fly-ball governor and shaft governors. All engines which require a disengagement of some of their parts in order to effect the cut-off are usually fitted with fly-ball governors. Engines of this releasing gear type are limited to a speed of about 90 revolutions, since

if the speed is increased beyond this limit, the values will not work properly.

In automatic cut-off engines having positive valve gears, the governors are of the type known as shaft governors, and are usually connected to engines having a high rotative speed.

In the Corliss type of engines, the governor is usually of the pendulum type, as shown in Fig. 8, but instead of acting on the throttle valve of the engine, it actuates the releasing mechanism, which in turn determines the point of cut-off. In

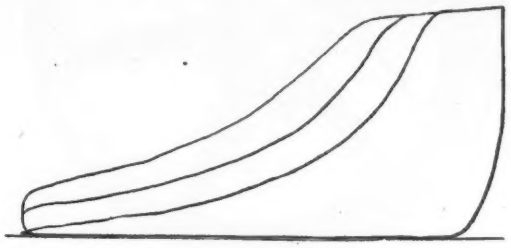

Fig. 7.

these engines there are four separate valves, two for the steam distribution and two for the exhaust. The exhaust valves are not affected by the governor mechanism, and hence the opening and closing of the exhaust are invariable and the load is constant.

Fig. 9 represents a Porter-Allen governor. This is a loaded pendulum governor and is used with comparatively high speeds, and represents a type which utilizes a fly-ball governor, yet the cut-off valves are actuated by a positive motion. The regulation of the speed is effected by altering the position of the block in a slotted link attached to the eccentric, which is fixed on the shaft, as shown in Fig. 10. The admission valves

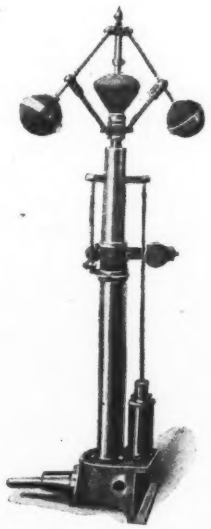

Fig. 2

receive their motion from the block which is moved by the action of the governor and thus varies the point of cut-off. The exhaust valves are driven from a fixed point on the link, and have an invariable motion. If the center of the block is brought to the center of the slot, the port is not opened at all, but if the block is brought to the end of the slot, as here rep-

Fig. 9.

resented, the steam is not cut off until the piston has reached six-tenths of the stroke, which is the limit of the admission. Fig. 11 represents three cards taken from a Porter-Allen engine with three different loads. It will be noticed, at light loads the expansion line crosses the back pressure line, forming a loop, which represents negative work.

Of the different types of shaft governors connected to a positive valve gear, the Straight-line governor is one of the

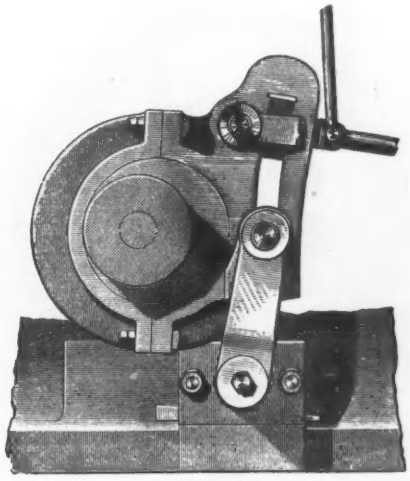

Fig. 10.

oldest types of fly-wheel governors. The Straight-line governor is illustrated in Fig. 12 and consists of a single weight carried on

one end of an arm which is pivoted in the middle to one of the arms of the fly-wheel. A metal strap connects one side of the arm to the end of a flat steel spring, while the other side of the arm is linked to the eccentric in such a manner that when the weight travels away from the shaft, which it does as the speed increases, the eccentric is shifted, altering both the eccentricity

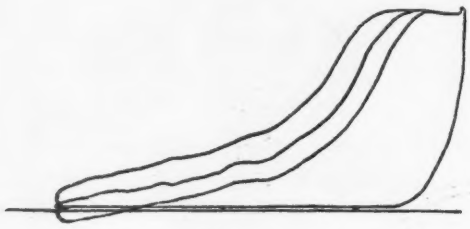

Fig. 11.

and the angle of advance, and thus regulates the cut-off to suit the load of the engine. The governor is adjusted by altering the weight of the ball, which is cast hollow and weighted with lead shot.

The Ball governor illustrated in Fig. 13, is similar to the Straight-line governor in this respect: that both the angle of advance and the eccentricity are varied in order to produce changes in the cut-off. In the details of its construction, it differs in many ways. Referring to the figure, it will be observed that there are two weights, two sets of spiral springs, and in addition a dash pot attached to one of the fly-wheel arms. The eccentric sheave is bolted to the hub of the fly-wheel, while the eccentric strap is made in two parts, the latter being a disc which carries a crank pin to which the valve rod is attached. The weights are connected by links to the eccentric straps, so that when the weights overcome the tension of the springs and move away from the shaft, the strap and disc

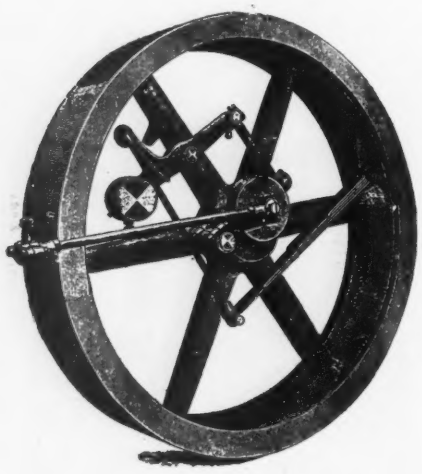

Fig. 12.

are rotated around the sheave, giving the pin a motion in the arc of a circle whose center is the center of the eccentric sheave, and in this way the desired variations of the eccentricity and angle of advance are obtained. The spring and dash pot are used for checking any undue movement on the part of the

Fig. 13.

regulating mechanism and insuring absolute control of the speed under the greatest variation in load.

The Advantages of Alternating Current in Transmitting Power.

The erection of electric plants all over this country and Europe is rapidly increasing, and one hears continually that it is an "alternating" current station of a very high voltage, and as the word alternating seems now to be affixed to almost all descriptions of power plants, it may be well to investigate some of the advantages of this current of high frequency as compared with its steady rival, direct current.

The direct current is one in which the current always flows in the same direction, while an alternating current changes its direction continually. The machines for generating both currents have the same fundamental parts, the armature and the field. The output of a machine is always taken from the armature. In a direct current machine, the current always flows from the positive brush to the negative one, but in an alternating current machine the voltage is continually changing, so that one part of the revolution the voltage is positive, at another it is negative.

In its most simple form the dynamo is an alternating current machine, and some of the best efforts of the early electrical investigations was exerted to make it a direct current machine until, finally, the arrangement known as a commutator was invented, which straightened out the current. As this was thought to be the ideal current, all efforts were directed to perfecting the direct current machine, as the value of the alternating current was not then fully known or appreciated. The direct current machines are divided into two classes, those for generating a constant current and those generating a constant voltage. The most important use of a constant current machine is in feeding arc light circuits, usually to lamps along the streets of a city. The constant voltage machine, or a machine of constant potential as it is called, is the machine most generally used to generate all classes of direct current. A

machine of this kind, in general, usually generates a voltage varying from 100 to 600 volts; the lower voltages being used generally for lighting plants, and the higher voltages for street car service. It has not been found convenient to generate a voltage much above 1000 volts in a direct current machine principally on account of the difficulties of commutation, and on account of the great cost and size of the commutator.

The power that a machine gives out depends upon two factors, the current and the voltage, the product of the two being the output in watts, kilowatts, or horse-power—whichever unit is desired. The direct product of a volt multiplied by an ampere is the unit called a watt. One thousand watts is a kilowatt and 746 watts is a horse-power, or, roughly, a horse-power is ¾ of a kilowatt. For any given number of horse-power that a generator gives out, if the voltage is a constant, the output varies as the current or load on the dynamo. Take for example a 1000 kilowatt machine generating current at 125 volts. The amount of current that the machine must generate in order to give out the required power is 8000 amperes.

The amount of power lost upon any circuit is proportional to two factors, the amount of the current transmitted and the resistance of the circuit. In a direct current transmission, it is directly proportioned to the square of the current and proportional to the resistance. The resistance of any circuit is usually made as small as possible in order to reduce this waste; but notwithstanding that, the square of such a large current as 8000 amperes will clearly illustrate the amount of energy lost upon the line.

The only method of satisfactory raising or lowering the voltage of a constant current circuit is by means of a rotary transformer, which is usually used only to raise or lower the voltage so as to maintain a constant potential, and when used as such is called a booster. It is in reality a motor-dynamo, the armature of which has two windings, one winding used for the motor and the other winding used to generate the required voltage. It also has two commutators, so that anything said about a dynamo generating direct current is applicable to it.

The constant current dynamo which is used for arc lighting generates, as its name signifies, a constant current, but the objection to its use in practice is its changing voltage. All applications of electricity in general use a constant voltage; the speed of a motor depends upon the voltage, the brightness of an incandescent lamp depends upon the voltage, and as these are the two principally applications of the electric current, it is important that the voltage remain constant.

The objections, therefore, of using direct current for the transmission of power, are the inherent defects of the direct current dynamo in generating high voltage; the excessive loss of energy in the transmission, the drop in the voltage due to this loss at the point of application of this energy, the system is not flexible to the changes of voltage necessary at different points of application and the enormous cost of large size of wire required for the line.

It is to overcome these difficulties that the alternating current machine was introduced, but the most remarkable development in the use of the alternating current for transmitting and distributing electrical power is mainly due to the facility and economy with which they may be transformed from one pressure or voltage to another. The transformer in its general form consists of an iron circuit around which is wound two series of wires in no way connected with each other. They are called the primary and secondary coils of the transformer. The primary receives the voltage from the dynamo and the secondary gives it out at any new voltage desired, either higher or lower. The ratio of transformation depends upon the number of turns in the primary and secondary. A transformer which has more turns in the secondary than in the primary is called a "step-up" transformer, because it raises the voltage, and when the secondary has fewer turns than the primary it is called a "step-down" transformer, as it lowers the voltage.

All the energy that is driven into a transformer is delivered except for the small losses within the transformer, so that if the voltage is high in primary and low in secondary, the current is high in the secondary and low in the primary. Step-up transformers find their chief use in generating plants, where, because of the practical limitations of the alternating machines, the current generated is not of as high a potential as is demanded for economical transmission. Step-down transformers are generally used at or near the place of consumption of energy, where the voltage is reduced to a degree suitable for the purpose it is to perform.

The maximum voltage of an alternating current generator is about 14,000 volts, because, on account of insulation, machines cannot practically be built to a much higher voltage. For very long distances, it is necessary to raise this voltage considerable higher on account of the cost of the lines, as the higher the voltage used the less the size of the wire required for the same efficiency and, therefore, the less the cost. The highest transmission thus far used in practice is 60,000 volts, used by the Standard Electric Co., of California. They transmit this voltage on a line constructed of aluminum cable ⅛ inch in diameter. When the distance is not very great step-up transformers can be dispensed with, as the voltage required on the line for economical transmission varies from 500 to 2000 volts per mile in length.

To sum up the foregoing, the advantages and disadvantages of each class of current for the transmission of power are as follows:—

The advantages of the direct current are, that its use is not attended by inductive disturbances with the accompanying drop of potential and sometimes low-power factor; it is attended by no appreciable capacity effects; it is not subject to electric disturbances which sometimes cause insulation perforations, short circuits and arcing. It permits the use of direct current motors with their satisfactory operation as to efficiency, small starting current overload capacity and speed control. Its principal disadvantage is the fact that it cannot be used at high voltages, and, consequently, for long distance transmission the cost of the line makes its use prohibitive. Furthermore, service conditions demand other voltages than those of the transmission line and the direct current transformer or dynamotor is expensive and not very efficient.

The advantages of the alternating current are its high voltage with its accompanying small currents, the use of the very satisfactory efficient and moderate price transformer, the small line wire required and cheap pole construction.

The disadvantages of the alternating current are the evil effects of inductance and capacity; the operation of alternating current motors are only fairly satisfactory and the great care that must be taken to provide good insulation, which is likely to break down when attended with internal disturbances, causing insulation perforations, short circuits and arcing.

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Increased Use of Water and Air Currents For Generating Power

The discussion as to how long the world's supply of coal will last serves to direct attention to the fact that every year the industrial world is getting away from the use of coal in many lines.

The electric arc is taking the place of coke and charcoal for reducing iron from its ores in blast furnaces and the electric furnace, while yet in the experimental stage, is doing the satisfactory work required of it. Wherever water falls there is power, and to-day the hydraulic, electrical, and mechanical engineers are working with the metallurgist to make electricity do the work of coal and coke in the manufacture of iron, copper and other useful metals. Waterfalls in the wilderness have been harnessed to dynamos which are sending the electrical current to cities 100 miles away. They are utilizing the electric current in furnaces to fuse clays for making aluminium; to make calcium carbide, which gives forth acetylene gas when combined with water; to weld iron and to make glass, and as this current works the same whether it comes from a dynamo driven by an engine or is brought scores of miles from a waterfall, it will doubtless be strange if any waterfall of any considerable size will be left to be admired in its primitive beauty.

Some of the plans for the future contemplate a dam across the Mississippi River at Keokuk, Iowa for a hydraulic plant capable of developing 50,000 horse-power, and the Ohio River at Louisville, Ky., will soon be hasnessed if the present plans are realized. Niagara Falls for some years has been driving immense turbines, and new ones are being installed as the demand requires. Seattle and Tacoma draw their electricity from the waterfalls miles distant and the mountain cascades in California furnish power which is carried a hundred or more miles to the place of consumption.

The aggregate power which can be furnished by all of America's waterfalls is insignificant compared to the possibilities which lie in the controlled energy which can be stored up in the winds and waves. Windmills are being used more and more in Europe and makers of windmills and other forms of motors driven by air currents say that before many years the land will be thickly studded with windmill towers, each wheel lifting water, operating a dynamo, or driving an air compressor, transforming the wind into useful forms of energy.

The limitless power of the waves and tides transformed into electrical energy, which can be transmitted by copper or aluminium wires far inland, is seriously being spoken of. Tidal mills and pumps operated by wave-moved floats have been in service in a small way for some years, but they have not proved to be satisfactory. It is now proposed to build, and a site has been about selected, for an immense reservoir which when filled by the tide will hold back sufficient water to work a large number of turbines until the next tide replenishes the reservoir. This reservoir will be a double one, each equipped with gates, One will furnish the head and the other will serve as the tail race while the tide is out. When the tide rises the gates of the lower reservoir will be closed, preventing the sea from entering and thus maintaining the lower level required for the operation of the water wheel.

An Army of Central Station Engineers

There has been recently issued from the Census Bureau an important report dealing with the number of electric stations and the number of station employees. This document is the first effort of this kind to do the work thoroughly, and this one is complete in every detail. According to these figures there were on June 30, 1903, 3,620 central electric stations in operation. The cost of their construction and equipment amounted to $504,740,352. The stations furnished employment to 23,330 persons, who received in wages $14,983,000 for the year. The power plant equipment consisted of 5,930 steam engines, with 1,379,941 indicated horse-power, and 1,390 water wheels with a stated horse-power of 438,472. The generating plants consisted of 12,484 dynamos of every description, with a stated horse-power of 1,624,980.

These figures do not include 252 electric railways doing a central station business, nor any data pertaining to the 50,000 isolated plants that exist all over the coun-

try. The current output for the year from these central stations was 2,453,502,652 kilowatt hours or about 25 per cent. of the possible work that the stations could do in 24 hours of daily operation.

The general introduction of electric lighting is shown by the fact that of the 1,892 places reported in the last census as having a population of 2,500 and over, 1,511 had one or more central stations, operated either independently or in connection with an electric railway and there were 1,960 places with smaller population than 2,500, having similar stations. In addition there were a number of large central electric stations which furnished current to surrounding cities, towns, and villages, so that an enumeration of the places in which central station were located by no means represents the distribution of the current.

There were 1,463 central stations operated in connection with the manufacture of gas, the operation of waterworks or other industries. It is interesting to note that there were only 827 cities and towns in which one or more gas plants were in operation for the manufacture of gas as an illuminant. The fact that 75 per cent. of the central electric stations are in places of less than 5,000 inhabitants, as compared with 22.8 per cent. of the gas plants, indicates the wider distribution of the electric stations which have enabled the inhabitants of the small places to enjoy illuminating facilities.

Illinois contains the greatest number of central stations operated under private ownership, and Ohio the greatest number under municipal control. The greatest proportion of central electric stations is found in the North Central States. In 1890 these States contained 43 per cent. of all the electric stations in the United States. and in 1902 the proportion had increased to 47 per cent. The greatest percentage of increase in the number of stations is shown for the South Central States, where 79 stations had been installed up to 1890, which number was increased to 404 in 1902.

—✦—

The Value of Training.

One of the most successful engineers of the present day and president of the American Society of Mechanical Engineers, Mr. James M. Dodge, has been investigating the relative progress in earning capacity made by the trained and untrained workmen. He finds that systematic schooling gives a handicap which is rarely overcome by the untrained. Mr. Dodge has divided the men who comprise the working force of a great industrial plant into four classes. The experience and knowledge, which constitute the workman's capital are valued at an amount that would yield at 5 per cent. interest per annum, an amount equivalent to the annual salary of the individual.

The lowest and most poorly paid workman is the laborer, who, with but primitive and rudimentary training necessitating his working constantly under the supervision of a boss, earns at the age of 21 his maximum, or $10.20 a week, representing for fifty weeks a year a capital value of $10,000.

The second class, or shop apprentices, enter the shop usually at the age of 16, at a salary of $3 per week. At the age of 21 he has already outdistanced the laborer; but at the age of 24 has attained his maximum wages of $15.80 per week, representing a capital value of $15,800.

The third group of workers are the young men who have had a trade school training. Starting at the age of 16, experience shows that they can afford to spend several years acquiring systematic knowledge, which enables them, after a short time, to command a better salary than the shop apprentice, and at any given age their compensation is greater, notwithstanding the time spent in school gaining theoretical knowledge.

At the age of 25, the earning value of these men, on a 5 per cent. interest basis is $22,000, so that the several additional years spent at the trade school represented an addition of $7000 to life's capital.

The fourth group tells of the highly trained technical school graduate. Leaving the regular public schools at 18, and spending four years in one of the higher institutions of technical learning, he begins life's battle at the age of 22, and commands on an average, about $13 per week. At this age he earns less than the apprentice, or the trade school graduate. In a short time he passes the apprentice, and in three years or at the age of 25, he is on a par with the trade school graduate but with better prospects for future advancement. His earning power continues to increase yearly at practically the same relative rate, so that by the age of 30 years his potential value is $41,000. In other words, six years of school training have augumented his value nearly 100 per cent. over what it would probably have been had he started with only a trade school training.

While this no doubt applies to the men who have had the advantages of an education such as mentioned, there are many engineers, and good ones, who have derived their training in another way. This training they have obtained by observing the many little things that go to make up the successful running of a steam plant and comparing their experience with others, and to the engineer who desires to keep abreast of the times, the technical journal is of the utmost importance.

By learning what others are doing who are engaged in work similar to his own, the engineer is enabled to increase his own knowledge, and by taking advantage of the advice and experience of others he greatly adds to his efficiency. The acquisition of such knowledge will often aid the engineer to make improvements of his own which may result in a considerable pecuniary advantage to him personally, and often to the engineering world in general

The Compressed Air Power Plant at the St. Louis Exposition.

The central compressed air power plant at the St. Louis Exposition will contain two main compressing units; one cross-compound, two-stage Cincinnati-gear compressor, having 13- and 24-inch steam cylinders, 22 and 14-inch air cylinders and 24-inch stroke, with a displacement at 125 R. P. M. of 1300 cubic feet per minute, and one cross-compound, two-stage, Meyer-gear compressor having 12-and 20-inch steam cylinders, 18-and 11-inch air cylinders and 18-inch stroke, with a displacement at 100 R. P. M. of 530 cubic feet per minute. The first machine is to supply the general compressed air requirements of the Exposition, while the second is to supply the transportation exhibits. The larger machine is of special interest as being the first compressor of its type publicly exhibited, although a number of similar machines have been, and are, being, installed in private plants. A 2800-foot machine is at the present time being placed in the Jersey City power house of the Central Railroad of New Jersey.

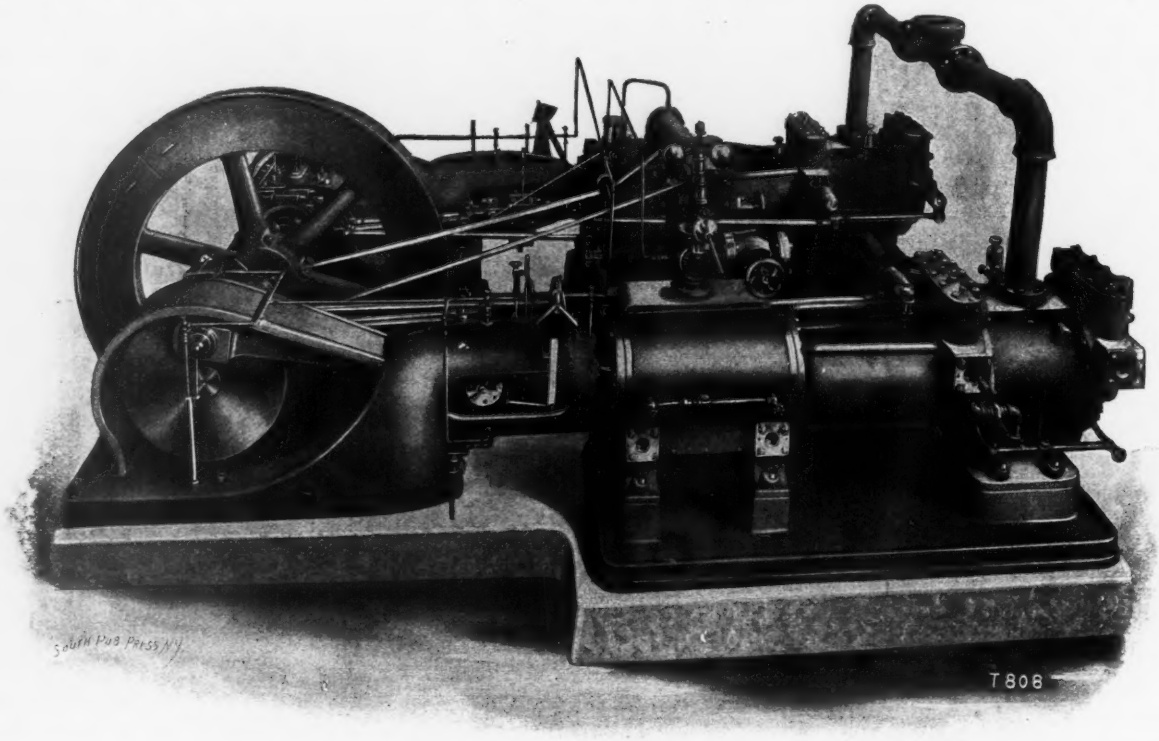


Fig. 1.

The general construction of one of these machines is shown in Figs. 1 and 2. The frames, as will be noted, are of massive construction, with a long bearing on the foundation, while the steam and air cylinders, joined in the direct line of thrust by heavy cast iron housings, are also supported by bed plates under their entire length, the weight of each side being thus taken on two large bearing surfaces extending to the ends of the machine, avoiding the objectionable features of over-hung cylinders, and giving the compressor great stability. The general construction is characteristic of the best grade of engine work, and comprises removable quarter boxes and main bearings, steel forged connecting rods, with wedge take-up, specially large crank and wrist pins and cast steel cross-heads with adjustable babbitted slippers, top and bottom, working in bored guides. The reciprocating motion is of the simplest possible character, this simplicity in construction permitting low reciprocating weights without sacrifice of strength. These features allow satisfactory balancing, and in connection with the long bearing on the foundations, insure an especially easy running machine. The steam valve-gear is of the four-valve type. Steam distribution is effected by means of short, double-ported, slide valves, working at either end of the steam chest on a valve face as close as possible to the cylinder bore, the port volume being restricted as far as the large valve area will allow. The exhaust valves are of the Corliss rotary type and are placed at the bottom of the cylinder. This construction has been followed in order to produce a valve gear having the essential advantages of a Corliss, namely separate passages for the steam and the exhaust with corresponding reduction in cylinder condensation, together with short, straight ports and small clearance. On the other hand, the complicated Corliss releasing gear, which is necessarily prejudicial to even moderate speeds, has been eliminated, the action being positive throughout.

The air valve gear is, however, the distinguishing feature of this machine, combining in a very ingenious manner, the positive action, noiseless operation and durability of the mechanically moved valve with the elasticity of the poppet valve. The noise and rapid wear of the poppet valve, due to the impact of the valves closing at the reversal of stroke, is eliminated by mechanically closing the passages underneath the poppet valve, and leaving a cushion of air upon which the latter seats. The action of the valve gear is clearly indicated by Fig. 3, showing the general arrangement of the cylinder, and Figs. 4, 5 and 6, showing the position of the valve at various points of the stroke.

At the beginning of the forward stroke of the piston, indicated by position 1 in Fig. 6, the mechanical valve "A" as shown in Fig. 4, is just closing the port "B," the discharge-edge of "A" being in line with the upper edge of the port "B," and the valve moving in the direction shown by the arrow "C." After the piston advances a short distance, the valve has reached the position shown in Fig. 5 in which the inlet edge of the valve "D" is just coming in line with the lower edge of port "B." The valve continues to move in the direction of the arrow "C" until about mid-stroke, when it reverses to the direction shown by arrow "E" bringing the valve back to the position shown in Fig. 5 at the end of the stroke, corresponding to position 3 on the ideal card shown in Fig. 6. On the return stroke, the valve still moving in the direction of the arrow "E" returns at position 4, (Fig. 6) to the position shown in Fig. 4, the discharge edge of valve "A" being in line with the upper edge of the port "B" and opening.

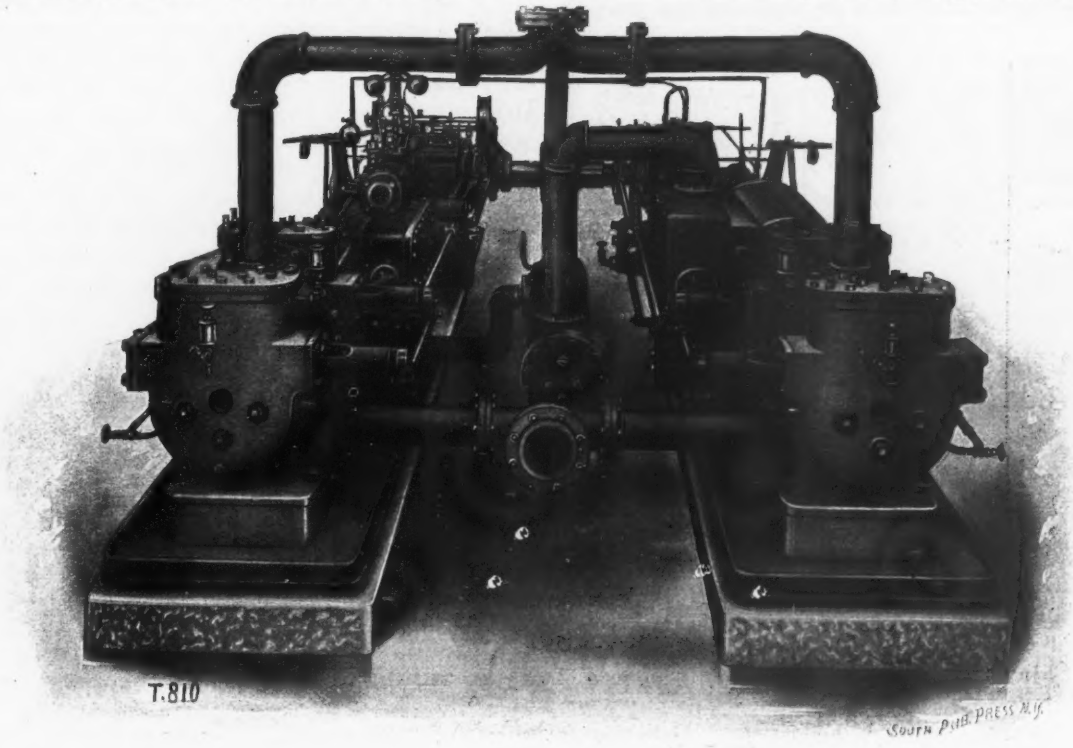


Fig. 2

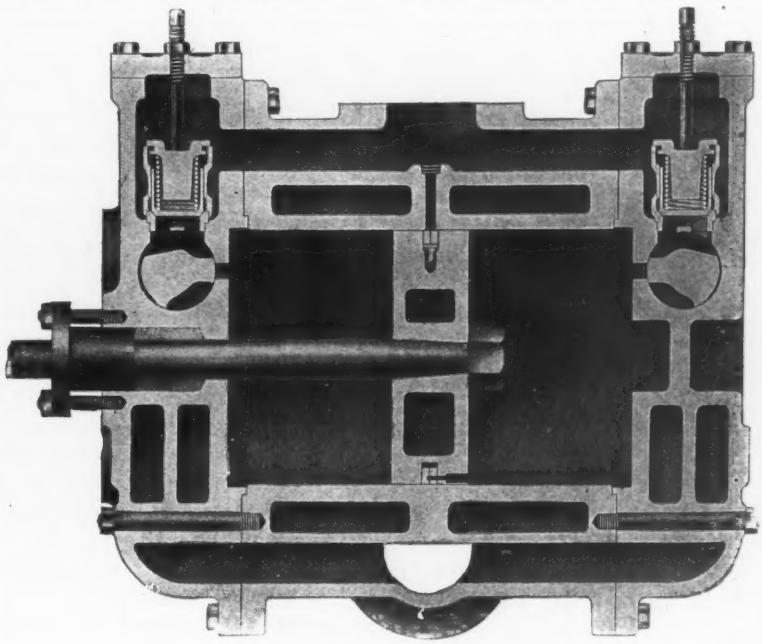


Fig. 3

After the mechanical valve opens, the poppet valves "G," which have had the entire return stroke in which to seat, prevent the flow of air back from the discharge passages to the cylinder, and remain closed until position 5 in Fig. 6 is reached, when the pressure inside the cylinder slightly exceeds the pressure in the discharge passages. The poppet valves "G" thereupon open and remain open until position 1, Fig. 6, is reached, at which point the valve "A," which in the meantime has changed its direction to that shown by arrow "C," has resumed the position shown in Fig. 4, thus leaving a volume of air under discharge pressure in the space between the mechanical valve and the poppet valve, permitting the light springs back of the poppet valves "G" to seat them easily and gently during the return stroke.

It will thus be seen, that the three fixed points in the compression cycle, namely, the opening of the inlet, the closing of the inlet, and the closing of the discharge are positively and mechanically controlled; the opening of the discharge, which is the only variable point in the cycle is controlled by the automatic poppet valves, which are relieved, however, of the

necessity for quick closing, and are consequently free from the objectionable features of noise and rapid wear.

Indicator cards from these machines have steep expansion line on the air cards, indicative of the small clearance and high

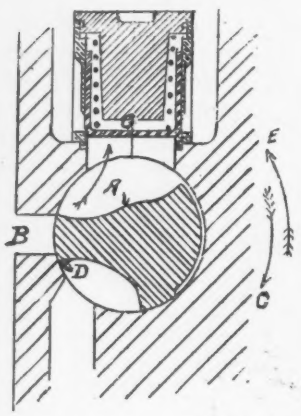


Fig. 4.

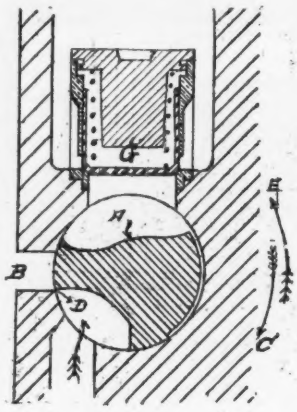


Fig. 5

volumetric efficiency of the machine, the large valve area being shown by the practical coincidence of the inlet and atmospheric lines and by the uniform discharge line. The rounded admission of the steam cards, which might, in ordinary engines be deemed objectionable, is due to the maker's practice of

Fig. 6

giving the steam valves a slight negative lead to off-set the expansion pressure at the beginning of the air cards.

These machines are built by the Laidlaw-Dunn-Gordon Company, of Cincinnati, O., U. S. A.

A Large Chimney.

A large chimney has just been completed by the Edison Electric Company at South Boston. The chimney, which is of the Custodis construction, is 250 feet 6 inches in height. The external diameter at the base is 24 feet 11¼ inches; internal diameter, 19 feet 6 inches. The external diameter at the top is 17 feet 4 inches; internal diameter, 16 feet 8½ inches. The walls of the chimney are 36 inches thick at the base for a height of 3 feet 9 inches, above which they decrease two inches in thickness in every 16 feet 5 inches until a height of 200 feet is reached; for the next 25 feet the walls are 10⅝ inches in thickness, and for the last 25 feet they are 8⅝ inches thick. The chimney stands on a concrete base 47 feet by 51 feet in area, 14 feet 2 inches deep.

Some Engineering Experiences.

By A Consulting Engineer.

It is looking after the little things that go to make up the difference between wasteful and economical steam engineering, and it is very important that we watch carefully those little things that we use so frequently. We unconsciously get more and more careless in their use, and become like most people, when they change their lighting system at home from the kerosene lamp to gas light. The first month each member of the home family watches lest there be a needless consumption of gas. At the end of the first month the bill comes in and we tell our friends how much cheaper it is to use gas than those old dirty lamps. Next month vigilance relaxes a little and the gas bill causes us some concern. About the third or fourth month gas has ceased to be a novelty and the gas bill has assumed such proportions that we begin to believe the gas meter is a thief and a robber placed in our house by and for the interest of a soulless corporation. When in reality the fault is wholly ours. The same principle applies to the man before the fire-door, with only this exception, "he don't have to foot the bill," and therefore is not reminded, at stated intervals, that his watchfulness is decreasing. One of the most important duties of a chief engineer is to see that the men under him are constantly watching these little things. The efficiency of his plant depends upon it.

We talk about the diplomacy used by our ambassadors and foreign ministers in their dealings with foreign powers, how about the engineer in charge of a large power plant? It seems to me that he is required to be just as cautious, use as much judgment, and be as diplomatic in his dealings with his employers and the men under him as is required of the most carefully trained statesman. An illustration: The Blank Manufacturing Company, employed a new chief engineer, a man thoroughly up-to-date, progressive, yet conservative. In short, he knew his business. It was predicted that he would not hold the position six weeks, the reason given was, that he would want to spend money fixing and cleaning up things that in most instances would appear like a dead loss of time and money, the Blank people having gone on record as being stingy and mean in regards spending money for the benefit of the power department.

Having had somewhat to do with this man's securing the position and knowing that if once the Blank Manufacturing Company were convinced that their power could be generated considerably cheaper, and incidentally, that if any important changes were made, I would be called in, as consulting engineer, the new chief and myself got our heads together for the purpose of starting the entering wedge. We knew that our fight would be with the superintendent, for his only idea of a power plant was that it is a necessary evil, and the less money spent for it in a given day is that much saved for the firm. After discussing conditions we felt that as no accurate detailed account of the cost of the power used had ever been kept it would be best to begin with that, especially as this work could be done by the power generating employees themselves; it could be made to be the means of showing the efficiency of the various employees, engines, boilers, etc., and also, if properly designed and used, it would act as a stimuli to create a desire among the men to do just a little better, along the lines of economy, than any of his fellow workmates.

Card No. 1 is for daily use. The chief engineer explained the advantages to the superintendent, got permission to have a small quantity printed, as an experiment, and also permission to get the time clerk to substitute them for a card which showed simply the date, number of hours, and employees name. Having authority, he next proceeded to interest the men in the plan; he went to each man and explained the object of the card, being careful to tell them that it was not a scheme to drive them, but that it was the beginning of a plan to better conditions under which we are working, for says he, you know this place has the name, (and justly I admit) of being the meanest place to work in that there is in the city; we want to work together to overcome that name. Another thing you will notice that you will get credit for all the extra work you do, you know that every day some of you fellows do some repairs that save the company a great many dollars, and no one knows that you do it. Another thing, if you or I order anything and there is a difference of opinion these cards will settle it at once etc., etc. The men knew their chief—had confidence in him—and entered into it cheerfully.

The card is almost self-explanatory. I might say, that at the end of each day it is filled out and signed by the engineer, fireman, or oiler, as the case may be, and left in a convenient place to be collected, approved, and sent to the time clerk's office. The chief engineer also fills out the new supplies ordered, new supplies received, and repairs ordered spaces. There also is a space provided for any remarks or memoranda the chief engineer may wish to enter on the card.

By this new system it became necessary to weigh all the coal used. This was done in the following manner: The coal was stored in bins from which it was loaded into small hand cars and hauled to the boiler room. These cars each held a certain weight of coal, and a record of the number of trips from the coal bin was kept by an old revolution counter placed inside of the boiler room in such a way that as each car went in, a

POWER EXPENSE. Wilmington Del. March 23 1901

BLANK MF'G CO.

TIME 10¾ HOURS.
NEW SUPPLIES ORDERED None.
NEW SUPPLIES RECIEVED Oiling set ordered 10 Mo 25 day 1901
SUPPLIES USED Three ⅞ x 4" bolts and nuts.
1 piece 6"x6"x⅛ sheet rubber.
POUNDS OF COAL USED
CUBIC FEET OF WATER USED METER NO
PINTS OIL USED 5 KINDS Pt. Cyl 4 Pts. Mchy.
REPAIRS ORDERED None
REPAIRS MADE Put new rubber and bolts in pipe flange.
REMARKS. Repairs made during working hours Time 30 min

Geo Watson ENGINEER FIREMAN
Engine No 6. Room 4

APPROVED
Hugh Brown Chief Engineer

Card No. 1

projection on the car pulled the registering lever forward, and when the car had traversed a certain distance a spring pulled the registering lever back ready for the next load. At the end of the day someone takes the reading of the counter and multiplies it by the number of pounds of coal each car was supposed to hold. The only trouble ever experienced with this device was when a new man was hired (and afterwards fired) he conceived the idea that by occasionally giving the recording lever an extra pull he would get credit for hauling more coal than

POWER EXPENSE ROOM NO 4. Geo Watson Engineer Fireman.

BLANK MF'G CO.

Month ending Mar 15th 1903	Corresponding month last year
TIME 224 HOURS	TIME 224 HOURS
NEW SUPPLIES ORD 5 gal Cyl Oil 1 bbl packing 4 pds grease waste 75 c.	NEW SUPPLIES ORD 50 lb soda ash for laundry 12½ gal Mchy oil 5 yds waste 45 c.
NEW SUPPLIES REC. All that was ordered	NEW SUPPLIES REC. All that was ordered
SUPPLIES USED ¾ gals cyl oil 8 pounds waste 75 c	SUPPLIES USED 1 copper gasket ½ yd waste 30 lb soda ash 17 lb used
POUNDS OF COAL USED	POUNDS OF COAL USED
CU. FT. WATER USED	CU. FT. WATER USED
OIL USED 6 pts cyl oil 4 gal Mch oil	OIL USED 7 pts cyl oil 2 lb tallow
REPAIRS ORD Cyl reboard and engine repaired by H.R Good & Co	REPAIRS ORD None
REPAIRS MADE Cyl reboard and engine overhauled by H.R Good & Co	REPAIRS MADE Stuffing boxes packed Nov 8th Expansion joint made by Mine

Remarks.
The expense for repairs are greater due to overhauling engine. For oil, waste, and repairs made by the engineer a saving of about 4% is shown.

J. M. Whitefield Superintendent

Card No. 2

did his predecessor, and so he did until his fireman began an investigation to find out why he, apparently was burning so much more coal than usual.

Each month a card like No. 2 was made out in the office, and a copy given to each person interested in the workings of the power developing department. Card No. 1 is about 6 x 5 inches, and Card No. 2 is about 6 x 18 inches. Necessarily I have changed the name, and the objects ordered and received are purely imaginary and are intended only to give an idea as to how the blank spaces be filled up. If any reader wants to use cards like these I would say we have no copyright on them and I would suggest that considerable blank space be left for the supplies, and repair notes. In adopting a scheme like this it is important to convince the men using it that it is not intended as an effort to drive them, but that it is only one of the many means adopted to satisfactorily manage a business that requires constant watchfulness of little details.

Fireless Steam Engine.

An engine has just been completed in Germany of a type designed for shunting in explosive factories. Instead of carrying fire in its own boiler, it is filled with steam from stationary boilers, and when so charged is capable of several hours work. The first warming up occupies half an hour, and the subsequent recharging can be done in a quarter of an hour.

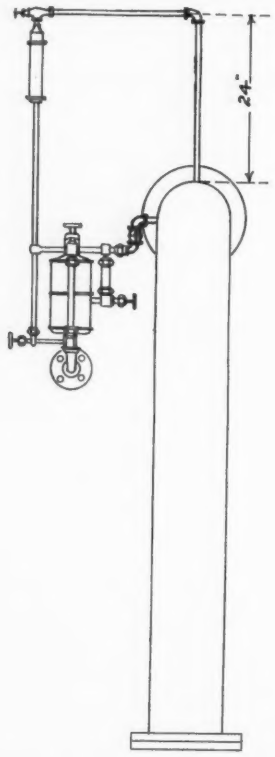
LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Sight Feed Lubricator.

EDITOR PRACTICAL ENGINEER:

In the January number of your valued paper I notice on page 21 one of your correspondents asks, what is the matter with his sight feed lubricator? In answer I beg to state that the trouble is, there is entirely too much piping used in the connecting of this lubricator. The steam that condenses in the upright pipe, which is about 10½ feet long, does not allow of any condensation in the siphon or water chamber, which is supposed to put a head on the lubricator.



Without any material change except the removal of this long piece of pipe and the plugging of the hole at the bottom of the riser, and the reconnecting of the lubricator in the other hole as per attached diagram, he can entirely overcome the difficulty, besides getting a much neater appearing equipment.

Fort Wayne, Ind. W. B.

Don't Grease Commutators with Your Fingers.

Advice about the running of Belts.

EDITOR PRACTICAL ENGINEER:

While reading a few days ago I saw the following, which I wish to comment upon a little.

"Singing or hissing of the brushes is usually caused by a rough or sticky commutator, or by the unevenness of the brushes. A slight application of vaseline to the commutator with the finger will generally reduce the noise."

To my mind this is poor advice, and should never be put in practice. My advice is, never put vaseline on the commutator with the finger when the generator is working.

All generators with more than two sets of brushes are liable to arc from one set of brushes to the other, and should one have his finger on the commutator at the time this arc occurs he would be liable to get a severe burn. I saw a young man who received a burn in this way and it nearly cost him his hand. You can rest assured he will not put any more vaseline on the commutator with his finger or get his hand so near the commutator again for any other purpose, unless the generator is not running.

A commutator wiper, which is much better than the finger for applying vaseline to the commutator, is made as follows: Take a piece of canvas 10 or 12 inches wide and long enough to make a roll one inch in diameter, larger or smaller, according to the wishes of the person preparing it; lay it out flat, spread one side with vaseline, roll up like a roll jelly cake, bind with a string, and you will have a wiper which will apply the vaseline very nicely and at the same time the liabilities of getting burned are practically eliminated. As the ends of the wiper become black and dirty it can be trimmed off, and the wiper will last for a long time.

A little farther along in this article appeared this statement, "A squeaking noise is generally caused by slipping of the belt, which should be tightened."

This seems to me like poor advice also, for every time the belt is tightened more pressure is brought upon the bearings of both engine and generator, consequently the frictional horse-power is increased, more steam has to be used to develop this additional horse-power. More steam means more fuel burned, a larger fuel bill at the end of the month and a bad prospect for an increase in the salary of either the engineer or fireman.

To my mind the better plan would be to first ascertain the cause of the slipping and then, if possible, apply a remedy. Belts will slip from one or more of the following causes: Dirty, greasy belts, belts too slack, belts too tight, belts too narrow for the work they are required to do, and overload.

Dirt and grease can be removed from belts by soaking the inner side with ¾ part of gasoline and ¼ part of turpentine. The dirt will then be soft and can be removed with a scraper. After scraping, the surface should be thoroughly cleaned with the above mixture. Small belts that can be readily removed can be soaked in this mixture with good results. After treating the belts as above, apply a good dressing and you will be surprised how slack the belt can be run and not slip.

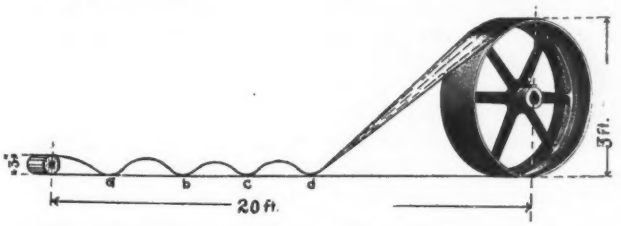
Should they begin to slip at any time, do not tighten but apply a little more dressing. After a belt has absorbed all the dressing it will hold, a slight application once or twice each month will prevent all slipping. A good grade of cylinder oil

answers the purpose very well and will do until the dressing can be obtained.

Of course, a belt can be too slack, and if so, no amount of dressing will prevent it from slipping. The only remedy in this case is to tighten it, but care and judgement should be used in doing so.

The writer saw a four-inch belt driving an electric light generator and the belt was slack enough to present the appearance shown in the sketch and yet it did not slip.

If I remember rightly the driving pulley was three feet in diameter and the driven pulley three inches, with about twenty feet between centers. The belt actually came together at a, b, c, and d.



We have in our power-house a 21-inch belt, 22 ft. between centres, running over pulleys 7 ft. and 24 inches respectively, which, when I took charge, was so tight as not to allow any slack in it when the load was on, and much trouble was experienced with excessive heating of the generator bearings. After treating as described in the foregoing we are able to slacken so that when the load is on there is a sag in the belt of from 8 in. to 12 in.

We have no more trouble with hot bearings, and if the load were steady it could be slackened still more.

My experience has been that a belt too tight will slip as well as one that is too loose, for when it is excessively tight not enough of the belt comes in contact with the pulleys to carry the load without slipping.

When the belt is too narrow for the work it has to do and there is room for a wider one, it would be a paying investment to discard the narrow one, or it may be disposed of to someone who is in need of a belt of that width.

When the belt is as wide as can be used and is overloaded, we are up against a hard problem. In this case, after cleaning, treat the belt with a good dressing, slacken as much as possible, and use a good idler, this is about the best one can do.

All belts should have the slack side on top, but when this is not possible an adjustable pulley should be used, placed under the belt as near the driven pulley as practicable. This pulley should be raised when the load is on and lowered when the load is off. In other words, raise the pulley when the machine is running and lower it when the machine is standing still.

All belts should be left very slack when not in use.

Lloyd, N. Y. A. K. V.

Heating Ovens or Kilns by the Use of Super-Heated Steam.

EDITOR PRACTICAL ENGINEER:

Can any of the readers of THE PRACTICAL ENGINEER give me any information in reference to heating ovens or kilns by the use of superheated steam?

We want to obtain a temperature of 450 degrees Fahrenheit in the ovens. If there are any such plants in this country, we would be pleased to learn their location and efficiency.

Philadelphia, Pa. J. V. REDMOND.

Rodney's Troubles

Or Do We Need a License Law in Michigan?

(Fourth Letter.)

wel mistur editur i thenk u veri mutch fer tellin me ov the dangir ov tyin the roap on tu the saffety valv leever and ile nevur sai thet a man is a fule whut kuts a roap whuts tide tu a saffety valve leever. insted ov thet ile taik oaf mi hat tu him evri tim. i found out thet the fellar whut kut the roap thet tim was a biler enspektur from nu yurk. henry hed bin tockin to him 1 day when he met him at thu appel groers convenshun at hard scrabbul in ovur streach kounty, and he told him tu kum out tu our place sum time and mebby he could enshure mi hul rig but it seams thet when he cut the roap thet he hez not kared tu kum bak. ime shure i dont no whi, fur i did not mis uze him in ani way. when he kum neer the biler thet tim he tuk no tim to tok, he jist kut the roap and flu lik a ginny hen ef u no how that iz. wel now mistur editur ef u se him ani whear tel him thears no moar dangur uv a xploshun fur ile ti no moar roaps on the biler.

ani whear ive hed a lot ov trubel with the grate bars, az henry cauls them. mi biler iz a porttubal biler with a watter bottum so henry cauls it and up tu tuday i thot it wus a very gud thing tu hev but ime not sattifide with it at awl. fathur allus told me never tu waist enny thing no mater how smal, so i tri tu bide bi hiz sa ens allus. u no thet kole kosts munny evri whear and ov korse i must saiv aul i kin, so whin i wus poken the fire yisteday i jist left the hot koles thet dropt thru the grates sta rite in the ash plase so az tu sav whut heet wuz in them. long in the afturnune henry kame along whur i wus thrashen barbners wheet. he luked in tu the ash pit and then grabd me bi the arm and sed thet if i didnt git them durned ashs out o the pit the grait bars wud faul down. i jist laft at him and sed i kuddent se how thayd faul down with sumthen tu help hold em up with. all rite hev it ure oan way rod, ule find out in a four nite. he wus so kind o cerrius thet i begin to think he ment it and i pulld the ashs rite out, wel that nite i tuk the masheen hoam with the teem, biler and aul, and ov korse nex day i had tu luk evri thing ovur tu se if it wus aul rite, and i found the grait bars as henry called them, aul bulged up in the middel so mutch thet 3 ov them hed feldown on the bottum ov the biler. wel i wuz in a pikkel. i didnt no whut tu du, henry wuz gon tu chirch and i wuz mad. wel a thot struk me in the hed and i tride it this way. i put the bars whut wuz very bad intu my lite waggun and druve 6 mils to warfels corners to wimers blaksmith shop. i wated thear neerly 3 ours fur gorg wimer the blaksmith tu cum home frum chirch, and whun he told me he kuddent straten a kast irren grait bar i thot he wus a pure mikkanik but when i got hoam mi bruther proavd him rite so ime gitten sum from the foundry, sum nu 1s, ile let u no when i get em.

rodney gumkirk

orkners corners

munrow kounty Meeshigan

cair of my fathur.

A Handy Centering Gauge. Tempering Springs.

Editor of THE PRACTICAL ENGINEER:

In the shop as well as in the steam plant we often meet with obstacles which must be overcome, and it often occurs that when time is limited these little troubles show up. A few years ago while employed in a shop I received orders from the foreman to get my tools together, and lose no time in reaching a steam plant located twenty miles from the shop. On reaching the plant it was evident that the engine needed attention; after putting in new stuffing box studs for piston rod, and removing broken packing and bull rings, I found that the piston came out so near the end of the cylinder that it was a difficult job to keep one leg of the calipers on the counter bore while centering the piston, the valves being in the heads of this engine. This accounts for the small portion of counterbores left after removing the head. After finishing the job I came to a conclusion to make something that I could use to better advantage in the near future, so I made a centering gauge as shown in the sketch. Fig. 1 is the back of the gauge, which is made

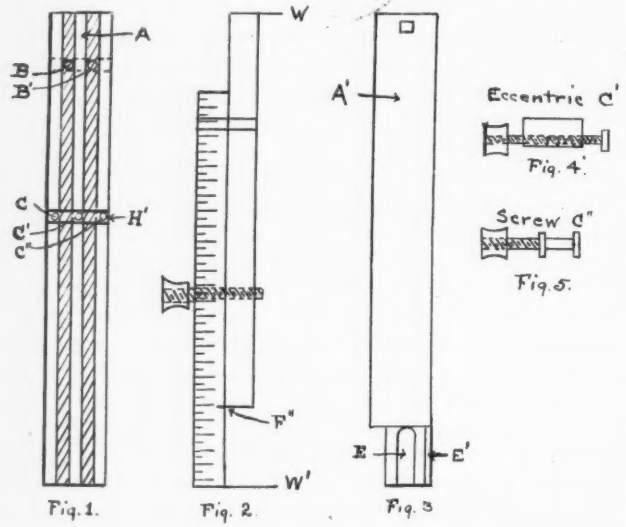


Fig. 1. Fig. 2 Fig. 3 Fig. 4. Fig. 5.

of tool steel 12 inches long, one inch wide, $\frac{1}{8}$ inch thick; three slots were cut in this bar the full length as shown; another bar the same width was made in Fig. 3; this bar slides freely up and down on bar Fig. 1. A strap is riveted to bar Fig. 1, as shown in BB', a sliding link was made at H', bar A' fits inside of these links as shown in Fig 2. To adjust the gauge try to get the length by pulling AA' lengthwise, say to within an $\frac{1}{8}$ inch, then tighten set screw c, which has no connection with bar A' as shown in Fig. 3. By tightening screw, C holds link H' from slipping on bar A; turn thumb-screw C', which is free to turn in slot E Fig. 3, and by so doing bar A' can be raised on account of this eccentric $\frac{1}{8}$ inch. Now by tightening thumb-screw C'' will hold bar A' in place, this screw passes through link H' and bar A' at E' and is made as shown in Fig. 5. Centres are put in ends of bars AA' as shown at WW' Fig. 2. A scale is cut on side of bar A as shown; a pointer is placed on bar A' as shown at F'' when the two bars are closed they measure from points WW' twelve inches and can be lengthened so they will measure twenty-two inches. I made three different lengths to go with A or B so I could measure 56 inches. I also made a short one for measuring or tramming shorter surfaces. This was twelve inches full length and six inches long when closed. This has come in very handy on many jobs and may be of use to others.

I had some trouble in tempering some springs which had lost their stiffness. I made several failures, but at last the thought came to me to try boiling hot water to dip them in; I did so, and then dipped them in oil and the trick was done. The cold water I first used made them too hard, the oil first used made them soft, but the hot water first and then the oil made a good job of it.

Cambridge, Mass. W. A. D.

Trouble With a Pump, and Trouble Caused by Having No Throttle at the Engine.

EDITOR THE PRACTICAL ENGINEER:

A short time ago I was called in to a small factory to see what was wrong with the boiler-feed pump.

It was not big enough, it would start only about half the time, and then it would only work by fits and starts. After fixing a price for my services, provided I got the pump to work all right, I looked the pump over. It was a bad mix-up indeed, for when the man in charge, could not get the pump to work he promptly proceeded to dissect it and when I took the matter up, the pump was scattered all over the fire-room floor. The water valves were thrown here and there and the steam valves were laid on a bench near the pump. The pistons were both out so I had to try them with steam after everything was connected up to make sure they did not blow through, for this is a serious drawback to a pump's efficiency.

In a very short time, the engineer had the pump together and everything apparently in working order. After warming up the steam end, and taking up the joints a little all around, and after I had gone over the piping, I told the engineer to start the pump just as he had been in the habit of doing previously. He opened the supply valve from the city main and turned on the steam to the pump, and then grabbed the handle to the stop valve on the feed line near the boiler and opened the valve as soon as he possibly could. The result was that the boiler pressure, leaking by the check between the stop valve and the pump discharge valves, forced the discharge valves down on their seats, and consequently the pump could not dispel the air to form a vacuum in the suction line. Not only that, but the air cock that had been in the water chamber of the pump was gone, and there was a plug in its place. I noticed also that the union in the suction pipe between the supply valve and the pump was dripping. I had it taken apart, after closing the supply valve. I found that the union had only a part of a gasket in it, and that was of paper. After putting in a new gasket in the union in the suction line, I put an air-cock in the discharge line near the pump, and carefully ground the check valve to make it tight, so that the hot water could not back into the pump. I then tried the pump by first opening the suction, then the vent valve in the discharge line, then gradually the steam valve. The pump started slowly at first, and after a few strokes, it forced the water out through the vent valve. Before closing the vent, I opened the stop near the boiler, then closed the vent and after giving the pump more steam it ran all right. They have not had any more trouble with it since.

Something happened in that place since I was there, that I foresaw when I was rubbering about the place. There was no throttle valve at the engine, the only means of shutting down the engine was by climbing on top of the boiler and shutting off the 2-in. stop valve. I noticed this condition and remarked it to the superintendent. He said that they had had no trouble since they took the throttle valve from the engine, and they needed it more in another place. As I was passing there the other day, I noticed the factory was closed. I stepped in and asked the engineer what was wrong, and he took me to the engine room and told me to see for myself. Sure enough, just as I thought, in fact, just what I had told the superintendent would happen, had happened. The engine, a horizontal center-crank, box-frame affair, had stripped the fly-wheel. The cross-head connection had let go and the piston went through the back head. The engine was so badly damaged that they found it cheaper to replace it than to repair it. I asked the engineer how it happened, and he said that the governor-belt broke, and when he tried to get up on top of the boiler to shut off the stop valve, the ladder used for the purpose was gone, and by the time he could shut the valve, the engine had done its work; he said he made an attempt to get to the governor and stop the engine that way but he had to go by the fly-wheel, and it was turning too fast for him, so finally after making a search he found the much needed ladder next door, carefully put away in a dark corner.

It seems that it was taken from the boiler setting while no one was around, and knowing that it was *only* used *mornings and evenings* to start and stop the engine, the man who took it did not think he had done any harm when he borrowed the ladder. It is useless to say that the factory superintendent and that man are on the outs.

ARKANSAW WES.

Blowing Down Boilers.

EDITOR THE PRACTICAL ENGINEER:

A little incident happened lately at a plant in Boston, which emphasizes the necessity of blowing boilers down a glass or so every day. The place in question had two six foot boilers, and two 65 h.p. engines direct connected to dynamos. Everything had been running along smoothly for some time, when suddenly the engines began to take water in wholesale doses, and knock and pound in a hair-raising manner. It was found that the boiler was priming in bad fashion. The chief appeared on the scene in a hurry. It was necessary to keep the engines running, as the building was a hotel full of tenants, with several hundred lights in operation. The chief stood by the throttles and drains two or three hours and took big chances, trying to keep things in motion. He was at a loss to account for the trouble; the boilers had plenty of steam space, and the water was not high.

Things went along in this way for an hour or two, until finally the night engineer and fireman put in their appearance. The former looked around for a spell and finally said, "I know what the trouble is, I think. That boiler has'nt been blown down every day."

Both the day and night firemen were consulted. The night man said it was the duty of the day man to attend to that. The day man said he blew the boiler every twenty-four hours. After a little further questioning he admitted that he sometimes skipped it now and then.

The blow-off was examined, and it had every appearance of not having been touched for at least three months. Moreover, on attempting to open it with a wrench, it was found to be stuck, and required nearly half an hour before it could be moved. It was a plug cock.

The chief decided to start the other boiler, as it was full of water and would'nt take long. As soon as steam was up, the new boiler was cut in, and the other one out of the circuit; instantly the pounding in the engines ceased, thus proving that dirty water was the cause.

ALBERT R. EMMONDS.

ST. LOUIS PUBLIC LIBRARY READING ROOM

Spooling a Pin.

EDITOR THE PRACTICAL ENGINEER:

Here is a steamboat trick that I have often seen practiced in marine engine rooms, but never ashore. It is applied on the crank-pin boxes of small bolt-connected auxiliary engines, such as blowers, circulators, etc. and is termed "spooling a pin." A bolt-connected crank pin box is shown in Fig. 1. When the box becomes loose, and the wear is to be taken up, the nuts are removed and the connecting rod separated from the brasses. Then a liner is removed from each side, and the brasses placed in position again. Now, to test it, to see whether it is too tight, the nuts are screwed down hard, without attaching the connecting rod. This involves quite an outlay of time, and it is necessary to do everything in a hurry aboard ship. So two metal spools are used, which are slipped on to the bolts in place of the foot of the connecting rod. Then only two or three turns of the nuts are required, see Fig. 2. Then the whole box can be moved around on the pin, making it very easy to get an exact fit. Any adjustment can be quickly made. This is termed "spooling a pin."

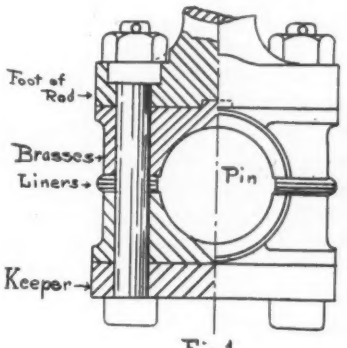


Fig. 1.

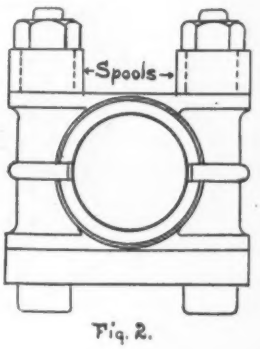


Fig. 2.

At the same time the connecting rod is swung back and forth to test for slack, and if it needs to be taken up it is easily done. Then connecting the rod to the box, the engine is run for a few minutes to see if everything is all right; then if there is no sign of heating, it is pretty certain that it will run a week or two without further attention.

Allston, Mass. A. R. E.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

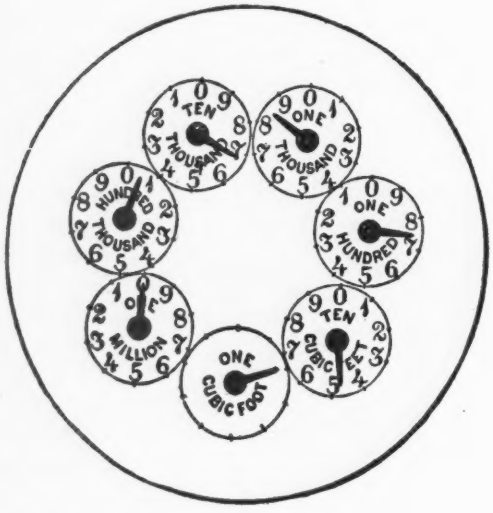
EDITOR THE PRACTICAL ENGINEER:

There is a controversy between our electrical engineer and draftsman in reference to the reading of the dial of the water meter. One says that you annex a cipher to the reading of the dial, and the other contends that you do not. It was referred to me, so I have proposed to leave the matter to the PRACTICAL ENGINEER and respectfully ask your opinion of the matter.

What we want to know is, do we have to add a cipher to the ten feet dial or not? This will decide a controversy in reference to a boiler test.

Baltimore, Md. T. N. G.

A cipher should *not* be added to the reading of the 10 feet dial. The pointer of the 10 cubic foot dial reads the number of cubic feet direct and must go around the circumference once before it registers ten cubic feet. The following directions and illustration may be of use to decide the correct reading.



If the pointer is between two figures, the smaller one must invariably be taken. Suppose the pointers of the dials stand as shown in the figure. Starting at the dial marked 10 cubic feet, we get the figure 4; from the next marked 100 cubic feet, the figure 7; from the next marked 1,000 cubic feet, the figure 8, and from the next marked 10,000 cubic feet, the figure 6; the reading is 6,874 cubic feet. The pointer on the 100,000 cubic foot dial being between 10 and the 1 indicates nothing. By subtracting the reading taken at one time from that taken at the next, the consumption of water for the intermediate time is obtained. The small dial marked one cubic foot gives the decimal parts of a cubic foot when fine readings are required and in the diagram it registers 0.8 cubic feet, so that the complete reading of the dial is 6,874.8 cubic feet.— ED.

EDITOR PRACTICAL ENGINEER:

Kindly answer me the following questions:

1. Will increasing the length of stroke increase the power of the engine?

2. When the length of stroke is increased, the crank arm is increased and the leverage is greater, so that why does that increase the power of the engine?

3. How fast will a piston move under so many pounds pressure?

4. What is the law regarding the flow of steam in pipes?

Portland, Oregon. J. M. S.

1. When the length of stroke is in creased, it increases the power of the engine, because the force acting on the piston acts through a longer distance. A horse does more work in pulling a wagon a distance of five miles than it does a distance of three miles against the same resistance. The force that the horse exerts is not greater, but it must exert that force a longer distance. Work is always the product of two factors; force multiplied by the distance through which that force acts.

2. This same thing applies to the crank pin of the engine. When the length of stroke is increased, the radius of the crank is increased, and, therefore, the diameter of the circle in which the crank pin revolves, is increased. While the force on the crank pin may not be increased, that force acts through a greater distance, as the circumference of the crank circle is larger.

3. The speed of a piston under any given pressure depends upon the amount of resistance that it must overcome. For any given engine, the speed is regulated by a governor which adjusts the pressure in the cylinder to meet the varying demands upon the engine.

The piston speed of an engine running a certain number of revolutions per minute is obtained by multiplying the length of strokes by the number of strokes per minute, and is usually measured in feet per minute. When this product is less than 500 feet per minute, the engine would be called one with a slow piston speed: between 600 and 800 feet per minute, the engine would be called a moderate piston speed engine, and if the piston travels more than 900 feet per minute, it is called a high piston speed engine.

4. A formula commonly used for velocity of flow of steam in pipes is

$$V = 50 \left(\frac{H}{L} \times D\right)^{\frac{1}{2}}$$

in which V = velocity in feet per second, L = length of pipe in feet, D = diameter of the pipe in feet, and H = height in feet of a column of steam, which would produce a pressure equal to the difference of pressures at the two ends of the pipe.

The value of H is obtained as follows: If p_1 = pressure in pounds per square inch of the steam at the entrance of the pipe, p_2 = the pressure at the exit, then $144 (p_1 - p_2)$ = difference in pressure per square foot. Let w density or weight per cubic

foot of steam at the pressure p_1, then the height of a column equivalent to the difference in pressures is

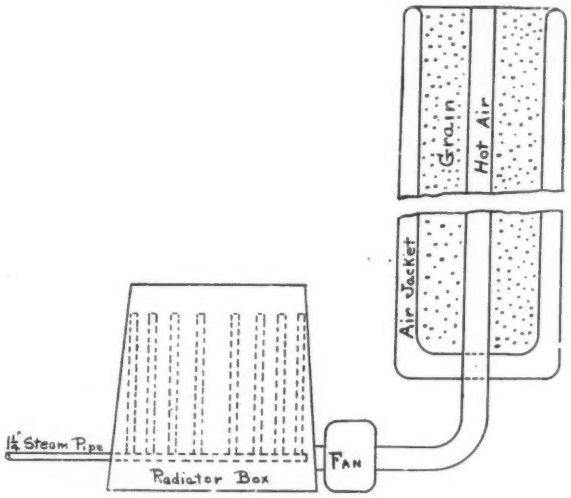
$$H = \frac{144\ (p_1 - p_2)}{W}$$

[ED.]

EDITOR THE PRACTICAL ENGINEER:

Will you kindly answer this through your paper?

I am running a grain dryer, the drum of which is 50 feet high. It is fed with wet grain from the top and the hot air is blown in at the bottom. There are three drums, the outer one being 56 inches in diameter, the second one is 40 inches in diameter, and the third one is 14 inches in diameter. The outside drum contains dead air which acts as a jacket, the center drum contains the grain, and the inside drum contains the hot air. The inside drum is perforated to allow the hot air to percolate through the grain.



The air is heated by a radiator which sets 125 feet from the boiler and has 500 feet of 1¼ inch pipe. It is enclosed in a sheet iron case. A fan 28 inches in diameter, with blades 12″ x 12″ blows the hot air through the dryer and runs 1200 revolutions per minute. The steam pressure of the boiler is 50 pounds per square inch, and has a 1¼″ pipe running to the radiator. A trap takes care of the condensed water. The accompanying sketch shows how it was connected. When the weather is cold we only get a temperature of 80 to 90 degrees, and we desire a temperature of 125 degrees.

1. What would be the best thing to do, increase the boiler pressure or increase the number of pipes in the radiator?

2. What horse power will it take to run two fans 1200 revolutions per minute with 6 blades 12″ x 12″ each?

3. What horse power is required to feed the present radiator and what additional horse power would be required if the radiator was increased in size one-half?

Bowling Green, Ohio. O. E. S.

1. Either increasing the boiler pressure or increasing the heating surface would give the desired result. It is probable, however, that increasing the number of pipes would give the best result, as the total heat in one pound of steam varies only slightly with a change of pressure.

2. It is impossible to say exactly without testing, how much horse power the fans use, but a fan of the size and speed as mentioned, will each absorb about 2½ horse power comparing it with tests made on fans of similar size.

3. The horse power required for the heating coil is obtained as follows:

The amount of heat given out by a radiating surface with indirect heating, as used here, is about 4.5 heat units per square foot of heating surface per hour, per degrees difference in temperature. The number of square feet of heating surface is obtained by multiplying the circumference by the length of pipe. The circumference of a pipe 1¼ inches in diameter is 5¼ inches, or about 0.44 of a foot. Area of heating surface is 500 x 0.44 = 220 square feet. As the radiator gives out 4.5 heat units per hour per square foot of radiating surface, the total amount of heat given out per degree difference in temperature is 4.5 x 220 = 990 heat units per hour per degree difference in temperature between the inside of the radiator and outside air. Steam at 50 pounds pressure has a temperature of 298 degrees and we will assume the temperature of the air in cold weather to be 10 degrees; then the difference in temperature is 288 degrees, so that the total heat given out by the radiating surface per hour is 288 x 990 = 285,120 heat units. This amount must be supplied by the boiler.

If one pound of steam at 50 pounds be reduced to water at a temperature of 80 degrees, it must give up 1125 heat units. As 285,120 heat units are required, the number of pounds of steam required is

$$\frac{285,120}{1125} = 253$$

pounds per hour. A boiler horse power is 30 pounds of water evaporated per hour from a feed water temperatuure of 100 degrees to steam at 70 pounds pressure. Using this same figure it is found that the horse power required for the coil is

$$\frac{253}{30} = 8.4$$

horse power. If the radiator was increased in size one-half, 4.2 additional horse power would have to be added.—[ED.]

Germantown Council.

Germantown Council No. 22 has elected the following new officers: Chief Engineer, John Brayman; Assistant, Wm. Kurtz; Recording, I. J. Rosboshil; Financial, Harry P. Fowden; Corresponding, Franklin MacIndoe, 3519 Ainsley St.; Treasurer, W. S. Wood; Senior M. M., John Atkinson; Junior M. M., Geo. C. Davis; Inside Sentinel, C. Bryan; Outside Sentinel, Louis Schlehner; Chaplain, Leidy F. Souders; Delegate to Grand Council, John P. Richards; Alternate, John T. Lee; Trustees, Geo. Akroyd, Wm. M. Leitch and Wm. Topley.

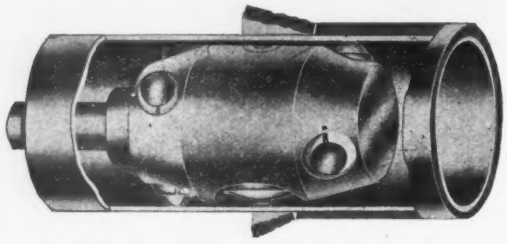
Energy Council.

The following new officers of Energy Council, No. 2, A. O. S. E., were installed Wednesday evening, Jan. 6th, by Supreme Chief Engineer, Noah R. Pierson: Chief, J. W. Lutz; Assistant, Alfred Dunkel; Recording Engineer, T. E. Easton; Corresponding Engineer, Philip Kirkwood, 204 S. Washington St.; Financial Engineer, Harry L. McGee; Treasurer, C. L. Schirmer, Chaplain, John L. Wiest, Senior M. M., Robt. Jenkins; Junior M. M., David Taylor; Inside Sentinel, Fred. L. May; Outside Sentinel, Thos. Devaughn; Trustees, Louis Foster, Robert Jenkins and John L. Norton; Delegate to Supreme Council, Thos. E. Eaton.

An Improved Boiler Cleaner.

The importance of preventing or removing all scale formations from boilers, for reasons of both economy and safety, is so well established and the difficulty of accomplishing it so well known that every advancement in this department of engineering is of peculiar as well as humane interest to both the man who pays the coal bills and the engineer in charge of the power plant.

Innumerable devices and means have been invented to prevent the formation of scale in the boiler, and on the whole the conditions have been slowly improved. Still in the light of

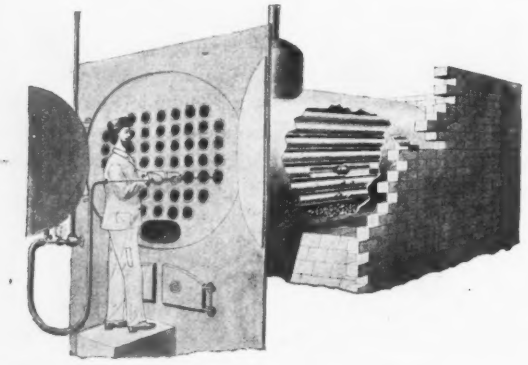


present knowledge, it may well be doubted whether any practical means can be devised that will positively insure the user against the presence of scale in the boilers.

The net result , therefore, is that from time to time the scale that has formed must be removed either by entering the boiler and chipping it off by hand, or using some mechanical contrivance for doing the same work.

To any one at all familiar with the construction of the boiler of to-day, especially the return tubular type, where the scale forms on the outside of the tubes, the impossibility of cleaning the tubes of this scale by hand is at once apparent, and is the chief reason for the great favor into which mechanical cleaners have sprung with the trade. The inspection of this form of boiler is so difficult that scale is very often present without being known by the engineer.

The construction of a return tubular boiler is such that all these mechanical cleaners have taken the form of some device or machine which has entered the tubes, and has a knocker or rapper that may be operated by hand or power, so as to rap or



hammer on the inside of the tubes sufficiently hard enough to jar the scale from the outside.

A careful study of the problem at hand has clearly shown that the most effective and least dangerous method of rapping the tubes consists in having the highest possible number of raps in a given time, which may be otherwise comparatively light blows, the effect of which will be to set up a more or less local but very rapid vibration to the walls of the tubes, which by reason of the more brittle and non-elastic character of scale formation, breaks up, loosens and shakes off the latter without subjecting the tube to any undue strain.

Keeping these points well in mind, The General Specialty Company, of Buffalo, N. Y., has devised a machine in which the motive fluid is applied in the most direct manner, thus insuring the greatest speed of piston and the double acting knocker rod, which is firmly secured to the former, in which the travel of the knocker rod is so limited that, though it is capable of exerting a sufficiently hard blow on the tube, it could not puncture it or injure it, because even if the tube were not present to stop the motion of the rod it would not travel beyond the point where the walls of the tube would be. This construction makes it possible to safely operate the machine at boiler pressure, thus obviating the necessity of using a separate steam gauge or reducing valve to lower the pressure.

For obvious reasons the body of the machine must be made considerably smaller than the inside diameter of the tubes, and this in connection with the rest of the construction, necessitates some means of accurately maintaining the machine in the axis of the tube. This is accomplished by two sets of centering lugs, one ahead and one back of the piston, which are forced out against the inner surface of the tube by steam pressure.

The undue heating of the tubes operated on is further avoided by so using the steam that is expanded to such a point before exhausting into the tube that its temperature is only a very little above that of the atmosphere.

An actual test of this machine showed a speed of 3000 strokes and upwards per minute, according to the pressure used, nor was the temperature of the tube at the end of thirty minutes raised so much but what it could be handled without gloves.

The cuts appearing herewith illustrate the cleaner in operation, and further information can be procured from the manufacturers, The General Specialty Co., 72 Carroll St., Buffalo, N. Y.

Suplee's Mechanical Engineer's Reference Book.

As indicated by the title, this book is devoted principally to the presentation of tables, formulas and reference data for mechanical engineers. It is, therefore, full of data in the portions relating to machine design and such information as will render it useful in the drawing room and in the designing department, the intention of the author being to render it available broadly in furnishing a record of general principles, as well as of detailed methods.

Some of the contents include a chapter on mathematics, mechanics, materials of engineering, strength of materials, machine design, heat, compressed air, water, fuel, steam, steam boiler, steam engines and internal combustion motors. The latter part of the book embraces a chapter on electric power, the cost of different kinds of power and the management of power plants.

This book is well printed, nicely arranged and thoroughly indexed throughout, a particular feature being the thumb index, so that any subject can be found immediately without turning to the regular index. J. B. Lippincott Company, of Philadelphia, are the publishers. Price $5.50. 834 pages, red morocco, flexible bound.

THE NEXT CONVENTION.

Supreme Council A. O. S. E. will meet at Allentown, Pa.

The Annual Convention of the Supreme Council American Order of Steam Engineers will be held in Allentown, Pa., commencing May 9th next. The call for the convention has already been issued by Supreme Chief Engineer Noah R. Pierson. It is the earnest desire of the Supreme Chief that each Council of the order shall have its full representation of delegates at the Convention, and the Supreme Chief also desires that as many visiting members of the order as can make it convenient will attend the session.

The members of Lehigh Council No. 15, of Allentown, are highly elated that their city has been chosen for the Convention, and they promise to show the delegates and visitors a good time while the convention lasts.

Allentown is one of Pennsylvania's most progressive cities; it is a veritable hive of industry, and is famed for the hospitality of its people. Lehigh Council has considerable over a hundred members and is capable in every way to handle a Convention without difficulty.

Further details of the arrangements, committees, etc., will be published in the March issue of THE PRACTICAL ENGINEER.

Atlantic City Council Gives a Banquet.

The following officers of Atlantic City Council were installed on Jan. 5th by Deputy Supreme Chief Engineer Joseph P. Whitley: Chief A. H. Franks; Recording and Corresponding, W. S. Price, Haddon Hall; Financial C. B. Smith, Treasurer R. S. Petersen, Chaplain Warren Morris; Senior M. M. Walter Ware; Junior M. M. Jas. Heenan; Inside Sentinel R. Endicott; Outside, C. F. Noble; Trustee J. A. Best, Delegate to Supreme Council R. S. Peterson and John A. Best.—Hurrah!

After the installation, the members repaired to the Hotel Central, where covers had been laid for seventy; a very enjoyable evening was spent.

The committee in charge of the banquet included W. S. Price, A. M. Plummer, J. A. Best and R. S. Peterson. Among the visitors present were F. R. Moore and B. J. Miller, of Philadelphia. Atlantic City Council now has fifty-one members.

Columbia.

Grand Chief Engineer Trout, of Pennsylvania, installed the following officers of Columbia Council No. 18, on Saturday evening, Jan. 2nd.: Chief Engineer, Daniel Eckman; Assistant, Wm. Raun; Senior M. M., Henry Messer; Junior M. M., John Schlossman; Corresponding and Financial Engineer, W. J. Courtney, 804 Walnut St.; Treasurer, Amos Simmons; Inside Sentinel, C. Mathort; Outside Sentinel, Ambrose Bartch; Chaplain, R. K. Grosh; Trustee, John McLane.

Philadelphia Council.

The new officers of Philadelphia Council, No. 7, were installed Jan. 6th by Grand First Assistant Engineer, John J. Kelley, assisted by Past Chief Clarence Muncy, and are as follows: Chief, Godfrey Knoss; assistant, Sheppard Adams; Senior M. M., Michael Helmstreit; Junior M. M., Chas. Corner; Financial, J. L. High; Recording Engineer, Wm. S. Wetzler; Treasurer, Wm. J. Eccles; Inside Sentinel, Frank B. Warner; Delegate to Grand Council, Clarence Muncey. Philadelphia Council has increased in membership and finances, the meetings are interesting and the attendance excellent, its location at the N. W. corner of Broad and Filbert Street is unexcelled. Engineers desiring to become members should communicate with the Secretary, W. S. Wetzler, 3717 Aspen St., West Phila.

A Useful Present.

At the regular meeting of Energy Council, No. 2, A. O. of S. E., of Baltimore, Md., Wednesday, Dec. 23d, 1903, Past Chief, Philip A. Kirkwood, was presented on behalf of the American Order of Steam Engineers of Maryland, with an artificial arm and all the improved attachments, such as hook, knife, etc., thus enabling him to follow his daily vocation as an engineer with unique dexterity and efficiency. Bro. Kirkwood will be remembered as having lost his arm in the discharge of duty at the refrigerator plant of Messrs. M. V. Smith & Sons, August 6th, 1903, an account of which was published in the September issue of THE PRACTICAL ENGINEER.

The presentation was made by Past Chief Harry L. McGee, who in a few well chosen words, reiterated how Energy and Maryland Councils had administered to the temporal wants and endeavored to alleviate the sufferings of Bro. Kirkwood during his affliction by sympathy and kindness, and now by this act the A. O. of S. E. of Maryland was endeavoring to supply the deficient member by an artificial one, and thus fulfill the objects of the order. Bro. Kirkwood in accepting the gift expressed his thanks andgratitude. Supreme Chief, Noah R. Pierson spoke, and noted the fitness of the occasion at this season of the year. In addition to the Supreme Chief and the members of Energy Council there were present a number of the members of Maryland Council, No. 1.

After the presentation and the adjustment of Bro. Kirkwood's arm, refreshments were served in which all partook, Bro. Kirkwood using his newly acquired member much to the edification of those present.

Milwaukee, Wis.

The new officers of Clifford P. Williams Council, No. 2, of Milwaukee, were installed by J. T. Harris, assisted by Wm. Sevright on Jan. 4th, after which supper was served in the Council room. Supper over, the boys proceeded to enjoy themselves by singing songs, making speeches and listening to the banjo and guitar played by Meyers and Burch, two of the new officers. Following are given the names of new officers: Chief Engineer, J. T. Harris; Assistant, Ed. Blauret; Recording L. Mahoney; Financial, F. Trogel; Chaplain, Yoss; Senior M. M., H. F. Peacock; Junior, F. Hayes; Sentinel, F. Burch; Trustee, H. Nothbohm; Delegate to Supreme Council, J. T. Harris.

Members of Manayunk Council Have a Lively Anniversary Reunion.

The members of old Manayunk Council, No. 9, American Order of Steam Engineers, have a way of enjoying themselves in fine style when they get together on one of the Council's birthdays, as they did Friday evening, Jan. 8th, 1904.

Brother George Richardson, who can handle the electrical department all right, chose Brother John Parkinson as his engineer on this occasion and we must congrautlate him on his good success at making coffee and his fine display of edibles upon the table.

In addition to the appetizing set-out, Brother Richardson entertained with his phonograph, Brother Ambuster kept up the gayety with his clever songs and jokes, and several brothers from Philadelphia also helped greatly along this line.

Manayunk Council has a snug sum in its treasury, and while not large in membership, 35 on the roll in good standing, yet the boys are all staunch supporters of the organization and would be pleased to add other good live engineers to their company.

TRADE NOTES

Mr. G. Frank Duemler, formerly representing in this city, the Pittsburg Gage & Supply Co., but for the past year at the home office in Pittsburg, has been appointed manager of the Philadelphia branch of the Dearborn Drug & Chemical Works, with handsome headquarters in the Bourse, where Mr. Duemler will be pleased to see any of his engineer friends.

We are very glad to know Mr. Duemler has returned to his home city and fully appreciate that this will be welcome news to his many acquaintances and friends. Both Mr. Duemler and the firm he represents being well and favorably known, their business of analyzing waters and supplying the celebrated "Dearborn Vegetable Boiler Compounds," will undoubtedly experience gratifying results.

Mr. Duemler was an operating engineer in Philadelphia for many years and an active worker in the various engineers societies where he made many warm friends. He is an energetic worker and a thoroughly good fellow.

The Lagonda Manufacturing Co., of Springfield, Ohio, Manufacturers of Tube Cleaners and Steam Specialties, have established an Eastern Office at 123 Liberty St., New York City. This will be in charge of Mr. H. A. Freeman, who has been connected with the Lagonda people for some time. The demand for their goods, especially in the East, having grown so steadily, it has been found necessary to establish headquarters there, where machines could be kept in stock, and from which information could be promptly furnished.

Mr. Freeman has extended acquaintance among the engineers and steam users in the Eastern territory, and will be glad to meet any of his old friends or any who may be interested in the machines he represents.

A handsome little celluloid calendar, suitable for the pocketbook or desk, has just been issued by H. B. Underwood & Co., 1025 Hamilton St., Philadelphia. The firm will send one to any engineer or steam user upon request. Also if your engine or pumps are affected with any of the numerous ailments peculiar to their kind, they will prescribe the remedy. Or, if your piston rings happen to be unsatisfactory they can tell you some interesting things about St. John Cylinder Packing. This well known firm have been repairing engines and pumps for a great many years and have a national reputation for ability and promptness. They send expert mechanics and portable tools anywhere upon an hour's notice.

As the features of the "Simonds Improved Receiver and Separator become known, the demands for these devices increase. That the parties are pleased with them, and consider that they made no mistake in purchasing them is shown by the many letters that Mr. Simonds receives from satisfied customers. After a years' service, Fuller & Rice Lumber and Manufacturing Co., write in high praise of it, and the Hygienic Food Co., Ltd., of Grand Rapids, who have used one for six months, write that the vibration of their Wickes vertical boilers has been entirely eliminated by its use, and that, without any bracing of the steam pipes Orders have been filled for these devices from the "Advance Thresher Co," of Battle Creek, Mich., for a device suitable for 1200 h.p. engine; Walsh DeRoo Milling Co., of Holland, Mich., for a device suitable for 250 h.p. engine; Compensating Pipe Organ Co., Battle Creek, Mich., for a device suitable for 150 h.p. engine, and Humphrey Manufacturing and Plating Co., Kalamazoo, Mich., for a device suitable for 100 h.p. engine.

A catalogue of books treating upon steam, steam engines, general mechanics and mechanical engineering, is always interesting to engineers. The new 96-page catalogue just issued by D. Van Nostrand Company, 23 Murray St., New York, is the most complete we have ever seen. It will be sent free upon request to any reader of THE PRACTICAL ENGINEER.

The Hartford Blower Company, of Hartford, Conn., have received an order for furnishing Exhaust Systems for the Buffing and Plating Departments of the N. Y. N. H. & H. R. R. Company, at their new shops, at Readville, Mass.

The apparatus consists of two special direct connected motor driven Hartford Adjustable Exhaust Fans, Hartford Patent Improved Dust Collectors, galvinized sheet steel piping, hoods, etc., with many new special fittings and attachments.

This order is a flattering testimony of the high quality apparatus furnished by this company, and one that they may be justly proud of.

The Davis Power Pump for boiler feeding, etc., is so well known that publishing a catalogue to describe it seems almost superfluous .However, the manufacturers, I. B. Davis & Son, Hartford, Conn. have issued a very nice catalogue showing the various styles of the pump, and giving data and information which will be useful to anyone interested in the subject. A copy will be mailed free to any engineer or steam user upon request. The same firm manufacture the well known Berryman Feed-Water Heater, Catalogues of which they will also mail upon request to any one mentioning THE PRACTICAL ENGINEER.

Mr. W. B. McVicker, Second Vice-President and Eastern Manager of the Dearborn Drug and Chemical Works, is in Chicago attending the annual meetings of the stockholders and directors of the company. Mr. McVicker will, on his return trip, spend some time visiting their several branches east of Chicago, stopping principally at Detroit, Cincinnati, Cleveland, Buffalo, Pittsburg and Richmond, Va. The company have opened a great many new branches during the year 1903, and their business has increased in greater ratio than any year in the past.

The France Packing Co., 6514 State Road, Tacony, Philadelphia, have just issued a new catalogue describing their well known "Steam Stopper" metallic packing, a copy of which they will mail to any engineer upon request. This catalogue also describes their "Steam Stopper" and "Water Stopper" brands of fibrous packings and other engineers' specialties all of which are illustrated.

Their plan to enable engineers to equip themselves with every tool they require, ranging from a monkey wrench up to a steam indicator, without sacrificing their own or their employers, interest, has proved an entire success, judging from the numbers who are availing themselves of it. Some time ago they placed on the market a new high pressure packing ring. It is made of the finest long-fibre asbestos yarn, and spun with a metallic wire. It has met with such success at the beginning that a number of railroads have adopted it exclusively for use on their locomotive air pumps.

The Sterling Pipe and Blower Co., Hartford City, Conn., are now building a 48" exhaust pipe head for the new Missouri River Power Station of the Metropolitan Street Railway Co., Kansas City, Mo., one of the largest that has ever been built.

The Cherry Chemical Company, 1215 Filbert Street, Philadelphia, Pa., manufacturers of the Red Seal Boiler Compound, wish to extend through this medium, many thanks to their friends and customers for the generous support during the past year.

By earnest devotion during 1904, they hope to double their business.

Mr. Oliver Braden, the genial Manager of this Company, has stated to us that they are better prepared than ever to meet the increased demands of their trade.

The Cherry Chemical Company make analyses of scale and water, free of charge. The only thing necessary is to send two ounces of scale, by mail, or one gallon of water, by express, prepaid.

This will enable them to supply you with the proper compound to give you the desired results.

STEAM PUMPS for

If you wish a pump for feeding boiler, for tank service, for pumping beer, whisky, oil, milk, hot or cold water, condensations, vacuum, air, jet condensers,

WILL-NOT THE SHORT-STROKE
"GREAT BURNHAM"
Battle Creek, STEAM PUMP Mich. U. S. A.

EVERY SERVICE

hydraulic pumps, artesian or deep well engines, etc., etc., write address

"UNION,"

BATTLE CREEK, MICH., U. S. A.

The Garlock Packing Co. have leased the entire building at 604 Arch Street, Philadelphia, where their local branch has occupied the ground floor for the past two years. The second floor is now being fitted up for offices, and the other floors will be used for stock and shipping purposes. When completed this will be the largest packing store in the world.

The Lunkenheimer Company, Cincinnati, makers of superior brass and iron steam specialties, report that owing to the unprecedented and growing demand for their specialties, they have again greatly increased their facilities, and are now in position to guarantee reasonably prompt shipments. They also report through their foreign branches an increasing export demand for their specialties and inform us that they will shortly place some new specialties upon the market which will be contained in a very complete catalogue to be issued in the course of a few months.

The Thompson Damper and Pressure Regulator is manufactured by Richard Thompson & Co., 126 Liberty St., New York. The feature of this regulator is, that it has the power to move the damper or dampers in both directions by water pressure, and is not of necessity wide open or shut. It will close or open the damper on a variation of one pound of steam, or will make a partial stroke in either direction and stand at any intermediate point between the open and closed positions. One of these regulators will govern from one to twenty boilers by working as many individual dampers, or one or more main dampers. It saves from 5 to 15 per cent. of fuel. An interesting catalogue can be obtained by writing, please mention THE PRACTICAL ENGINEER

Last month we referred to the large purchases of Stephenson Bar Belt Dressing made by the Rochester Stamping Co.

Stephenson Manufacturing Co., of Albany, N. Y., advise us that they have had any number of requests for free samples, which they send by mail, as a result of the article in question. They now offer to give any reader of THE PRACTICAL ENGINEER an order on his supply dealer for a pound stick absolutely free of charge if he mentions this paper when writing them.

The Steam Specialties of the Wright Manufacturing Co., 94 Woodbridge St., Detroit, Mich., are illustrated in a very attractive catalogue just issued by them. These specialties have been developed and perfected by them in the course of many years of specialization, and are offered to the steam using public with the entire confidence that they will be found fully equal to the more and more exacting requirements of modern steam practice. Their entire efforts are concentrated in the manufacture of the Wright "Emergency" Steam Traps, Wright "Victor" Low Pressure Steam Traps, Improved Safety Water Columns, "Cyclone" Exhaust Heads, etc., each of which has been the subject of careful study and experiment. Correspondence is invited, and any inquiries will receive prompt and courteous attention. Copies of their catalogue will be mailed upon request.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 214 and 216 S. 3d St., Allentown, Pa.

WANTED ENGINEERS AND SALESMEN

To handle France "Steam Stopper" brands of Metallic and Fibrous Packing as a side line. Good inducements to right party. Address

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THE BURT EXHAUST HEAD

Stops the spray and dripping of water from the exhaust pipe and allows nothing but absolutely dry steam to escape.

The Chapman Coal Co., Jackson, Ohio, say after using a Burt Exhaust Head, "No more trouble from spray and dripping roofs."

Send order with size of pipe today. If the BURT EXHAUST HEAD prove unsatisfactory, return.

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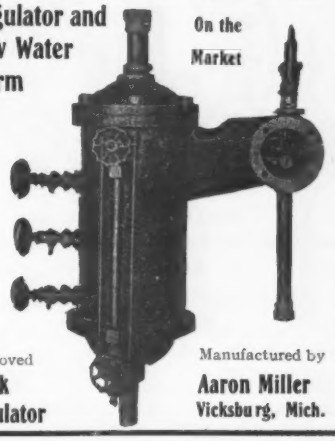

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Manufactured by Aaron Miller Vicksburg, Mich.

VISCOSITY, often called "body" or "thickness," of an oil is that quality which enables it to resist pressures. This is always at the cost of friction in the oil itself. The presence of even a little *Dixon's Pure Flake Graphite* in every bearing, in every cylinder and valve, will enable the engineer to use thinner oils, making a double reduction in the friction load.

Get Booklet No. 96c and a sample.

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ENGINE ECONOMY
COCHRANE STEAM SEPARATORS

A Cochrane Steam Separator protects an engine from the danger occasioned by the presence of large quantities of water in the steam pipes. But, in addition, it increases the economical running of the steam engine by reducing the "initial condensation." It does this by supplying dry steam to the engine, thus decreasing the amount of water in the cylinder. Decreasing this amount of water means that less heat will be stolen by water from the cylinder walls. Therefore, less heat will be taken from the steam to re-heat the cylinder walls to their normal temperature, the pressure of the steam entering the cylinder will be maintained nearer the maximum, and the steam will perform more work than it could if it had to give up more heat to the cylinders because of excessive initial condensation Thus, step by step, you can trace the effect of a Cochrane Separator in helping to keep down the steam consumption of the engine. The saving which results from this will pay for the cost of the Separator in a comparatively short time. A Cochrane Separator will also enable you to obtain better lubrication in the cylinder—and with less oil, so that while reducing the wear on the cylinder, piston and piston rings, the Separator also reduces your oil bill. Ask for our **Catalogue 16-S.**

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Manufacturers also of the Cochrane Feed Water Heaters and of the Sorge-Cochrane Systems.

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are reqnired in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

SUPREME COUNCIL OF THE UNITED STATES.

Supreme Chief Engineer.—Noah R. Pierson, Fidelity Building, Baltimore, Md.
Supreme First Assistant Engineer.—W. S. Price, Haddon Hall, Atlantic City.
Supreme Recording Engineer.—C. W. Leng, 1556 East Montgomery Ave., Philadelphia.
Supreme Corresponding Engineer.—Jas. L. Stallings, 3006 Dillon St., Baltimore, Md.
Supreme Treasurer Engineer.—Geo. W. Richardson, 3728 Manayunk Ave., Wissahickon, Philadelphia.
Supreme Senior Master Mechanic.—A. Keppleman, 131 Buttonwood St., Reading, Pa.
Supreme Junior Master Mechanic.—Joseph T. Harris, 1611 Clybourn St., Milwaukee, Wis.
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DELAWARE.

Deputy Supreme Chief Engineer, David J. Stayton, No. 513 Searles St., Wilmington.

WILMINGTON.

Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Chief Engineer, Clark Franklin. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

LOUISIANA.

Deputy Supreme Chief Engineer, John W. Angers.

NEW IBERIA.

Evangeline Council. Chief Engineer, John B. Lanaler. Corresponding Engineer, W. J. Maynard.

JENNINGS.

Jennings Council, No. 2, meets every Saturday evening in American Bank. Chief Engineer, Daniel R. Jones. Corresponding Engineer, R. E. Funk.

MARYLAND.

Deputy Supreme Chief Engineer, A. J. Deffdrich, 226 North Caroline St., Baltimore, Md.

BALTIMORE.

Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, L. Smithers. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. G. Daneker, 434 East Ave.

MASSACHUSETTS.

Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

BOSTON.

Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, inthe Hall, 262 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Forestere Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

NEW JERSEY.

Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

PERTH AMBOY.

Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at S. E. corner 2d and Arch Sts. Chief Engineer, S. M. Best. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, John A. Best. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Wm. F. Pond. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 12, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, George T. Lee. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, Ed. C. Ricker. Corresponding Engineer, Ernest Ritsert, 2229 Frankford Ave., Philadelphia.

DO YOU WANT AN ENGINEER? WANT A POSITION?

Scores of chief engineers secure their assistants, firemen and oilers by 'phoning our *Mechanical Department*. Scores of superintendents secure their chief engineers in the same way. We have a well-selected list of men constantly registered with us. We will promptly supply you with a man whose past record will stand investigation, and our service to the employer is *free*.

The engineer's wants are our specialty. If you want either a good man or a good position write us for particulars. We have supplied hundreds of engineers who are now operating plants satisfactorily in all parts of the city. If we can be of service to you, write us, or

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The Cure: Use

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ANTI-FRICTION

Fig. 1. Photograph of Packing before being placed in stuffing box.

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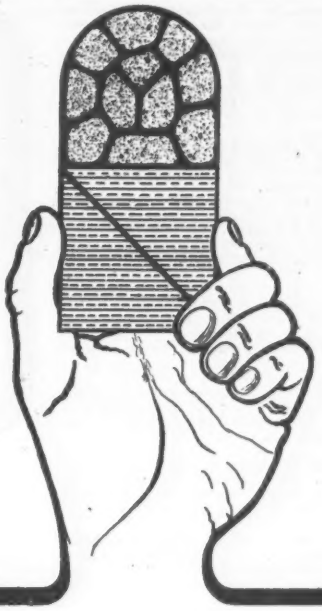
Brothers Freund, Vienna, III, Marxergasse 4 (Continental Europe).



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why Daniel's P. P. P. produces less friction on the rod, and consequently effects a saving in the coal bill—why it lasts longer, making it easier for the engineer. The combination of the *sliding wedge principle*, with the *permanent elasticity* of the packing itself, makes

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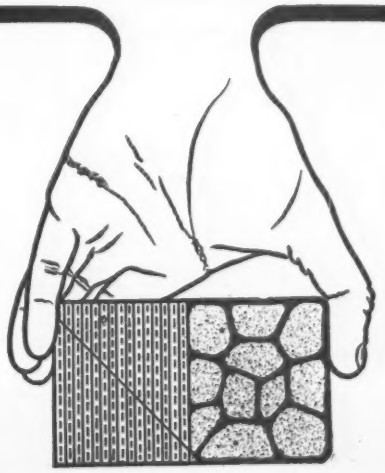
a perfect SELF-SETTING packing. These two principles are requisite to an ideal, self-setting packing, and P. P. P. is the only packing combining them. Therefore, Daniel's P. P. P. is the only truly self-setting packing. If you doubt it, send for our booklet, mentioning this paper, and be convinced. If you believe it, try some of the packing, and be satisfied.

Quaker City Rubber Co.

Philadelphia and Chicago.



Southwark Council, No. 4, meets every Monday, at Cor. of Reed and Eighth Sts. Chief Engineer, Hugh Ryder. Corresponding Engineer, J. C. McDowell, 1913 South Eighth St.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. Cor. Broad and Filbert Sts. Chief Engineer, Harry Dunn. Corresponding Engineer, W. S. Wetzler, 3717 Aspen St.

Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, Andrew Roberts, Sr. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Tuesday evening at the Hall, 2550 Emerald St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John evening at 639 Hamilton St. Chief Engineer, Henry C. Snyder. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Chas. Quinter. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, John Kellenberger. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, John McLane. Corresponding Engineer, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, R. D. Mantz. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Chief Engineer, J. T. Harris. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

TEXAS.

Deputy Supreme Chief Engineer, S. A. Bisbey, care of Cotton Compress and Warehouse Co., Galveston.

GALVESTON.

Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.

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Always have a Water Seal over the valve and never blow steam; neither do they back up water

REDUCING VALVES
EXHAUST PIPE HEADS,
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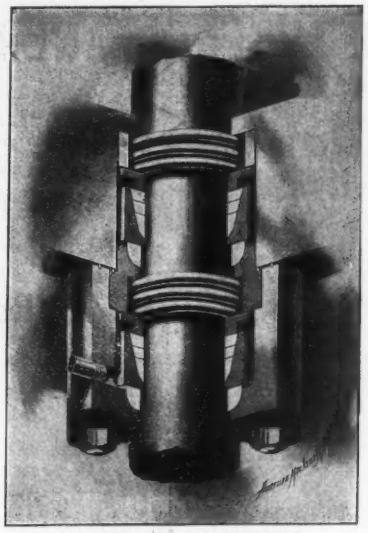

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Do their work well.

Their use will save you considerable money and endless trouble.

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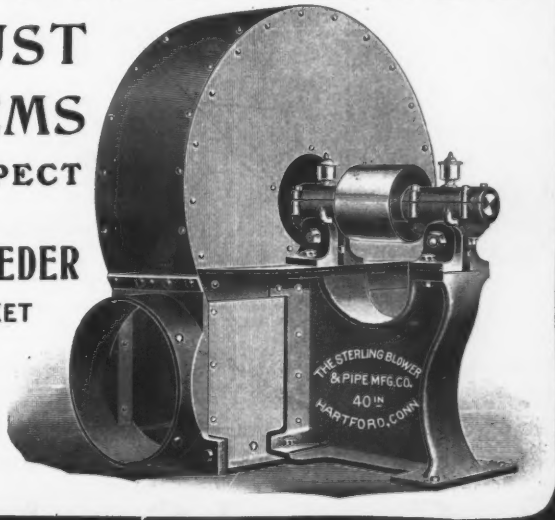

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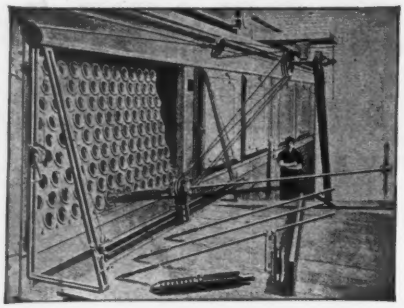

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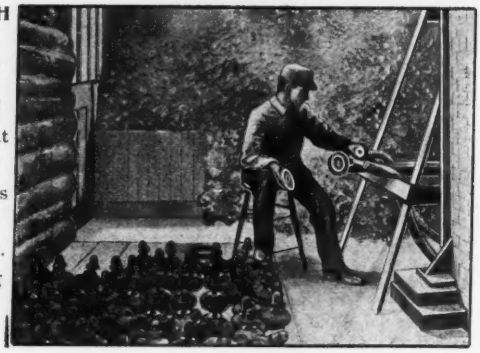

THE LAGONDA MFG. CO.

BOILER CLEANING EXPERTS

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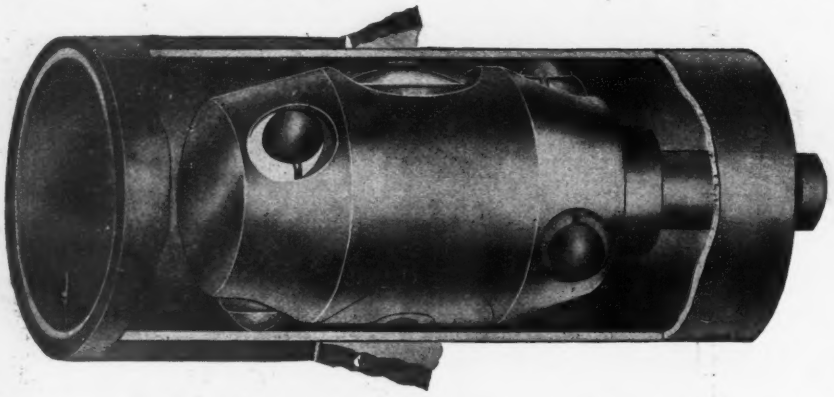
THE "TORPEDO"

WILL REMOVE ALL BOILER SCALE



from the outside of the tubes of fire tube boilers. These are by far the most difficult boilers to clean, as practically all of the scale is beyond human reach, and ordinary methods leave most of the scale on the tubes.

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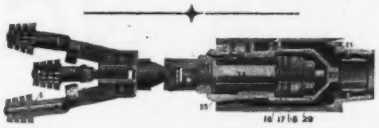
Boiler Tube Cleaners
Blow-off Valves



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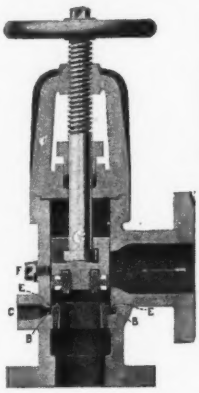
will clean tubes more thoroughly, at less cost, and in less time than can be done by other means. **This we Guarantee.**

We also make the **Niagara Turbine Tube Cleaner.**

We have suit for infringement of patents against a user of the Weinland machine, and will sue all other infringers.



THE FABER BLOW-OFF VALVE
washes its face every time it is opened and closed.

A connection at C admits steam at boiler pressure to chamber B, whence it escapes through slot E all around the seat, and sweeps both seat and disc free from sediment just before closing. It will last as long as a steam valve without leaking.

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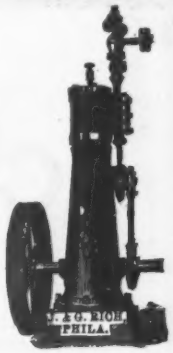

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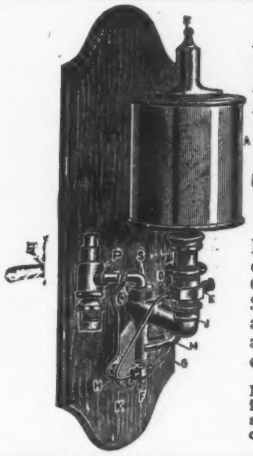

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Manufactured by
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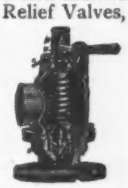

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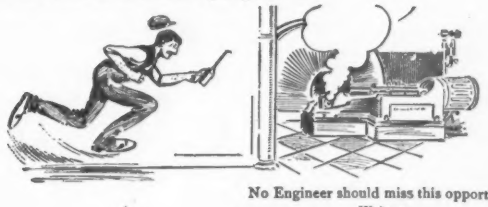

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WM. W. NUGENT & CO.
20-22 W. RANDOLPH ST. CHICAGO, U.S.A.
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ST. JOHN SELF-ADJUSTING
CYLINDER PACKING

It is false economy to put a good piston and packing into a cylinder that is out of round. If you put a good house on a poor foundation, both you and the house will be poor in a short time.

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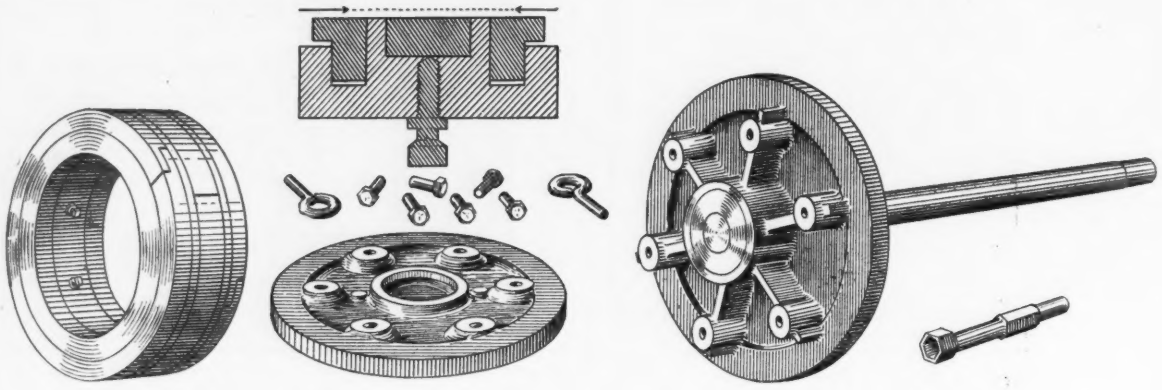
A very slight leak in the cylinder of an engine making sixty revolutions a minute, running nine hours a day, means a large loss of coal every week, and this means money, as it takes the coal to make the steam, and money to pay for the coal.



The St. John Piston and Packing have stood the test of over fourteen years in actual use, and the practical use of it and the satisfactory results obtained, are the best proofs of its efficiency.

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From Carbon Iron and Steel Co., Parryville, Pa.

Since putting your St. John Packing on our engine, we are getting better results from her, and are using 25 per cent. less boiler capacity to do the work.

From the Reading Paper Mill, Reading, Pa.

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Our specialty is repairs to engines. When you have work of this kind done, have it done right; it pays in the end.

We don't do or recommend cheap work

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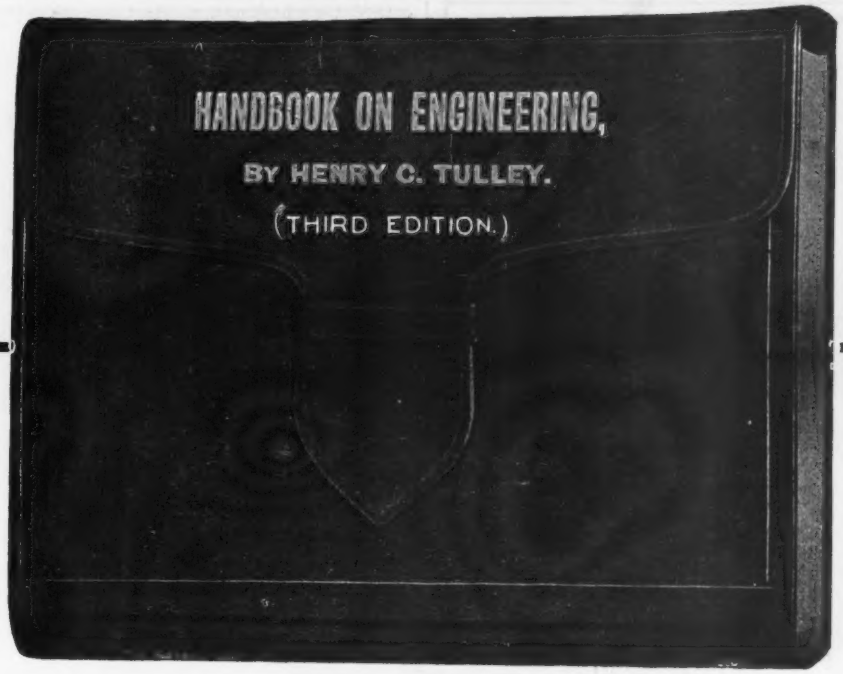

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Is not a "Just as Good" Trap. It is "Better" than others, more simple in construction and operation; reasonable in price, and guaranteed to give satisfaction. Insist upon having the **H. H.**

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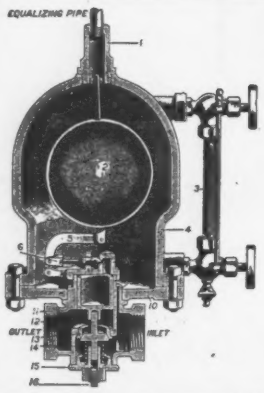

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This Trap is especially adapted for Separators. We also manufacture Thermostatic Steam Traps. Sent on 30 days trial to responsible parties.

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does not depend upon clockwork, or floats, or springs; has no balance valves, or pet-cocks, or screws, or rotating parts to get out of order.

Saves its cost in coal in six months, and we give you thirty days trial to find that out.

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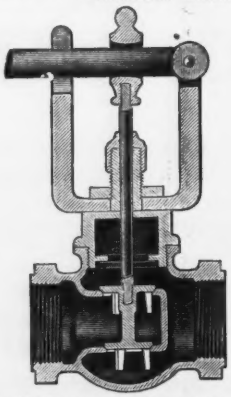
For Pressures under 70 Lbs.



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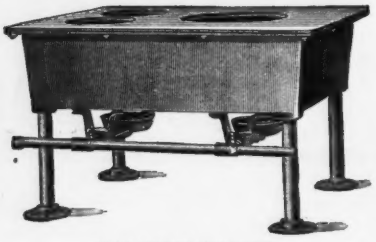
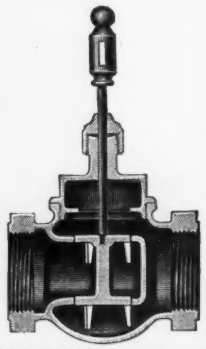


GAS GLUE HEATER



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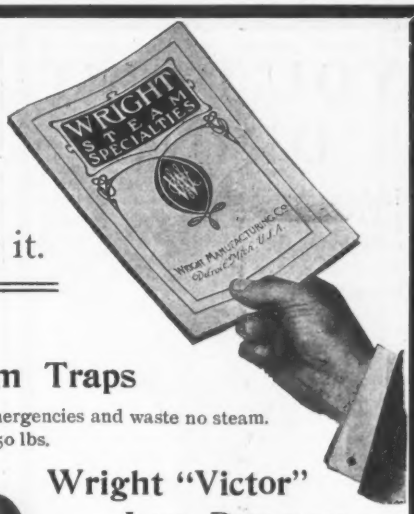
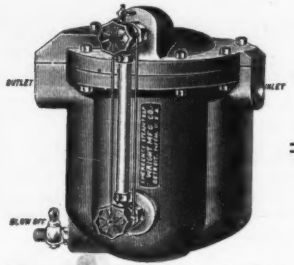
It is for those engineers who believe in new and improved equipment, and contains much useful information. A postal will bring it.





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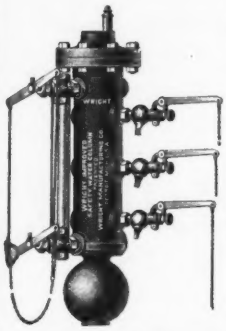

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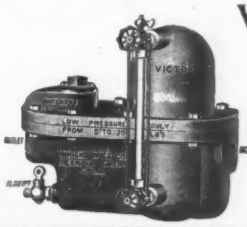

Wright "Victor" Low Pressure Steam Traps

For steam pressures from 0 to 20 lbs. and a wonder. The outlet valve is approximately as large as the connecting pipe — affording enormous capacity.

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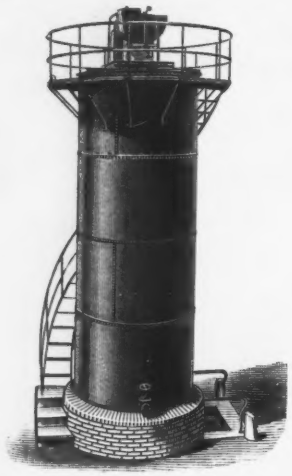

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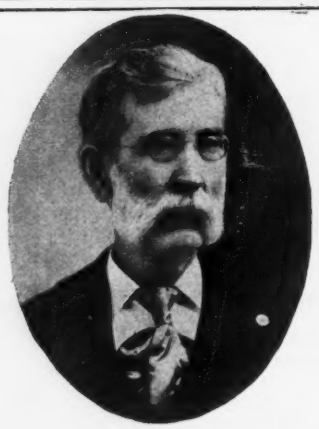

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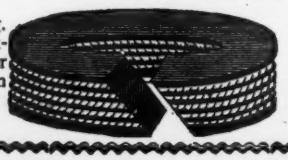

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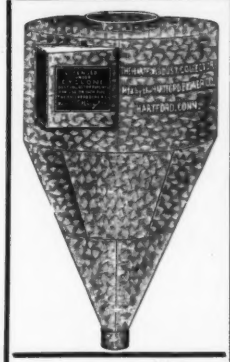

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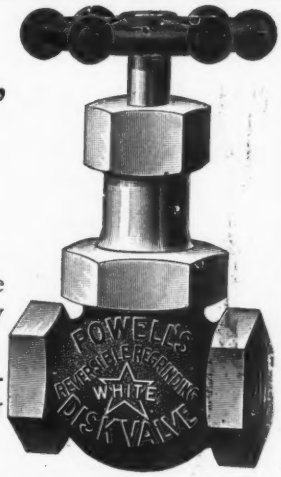

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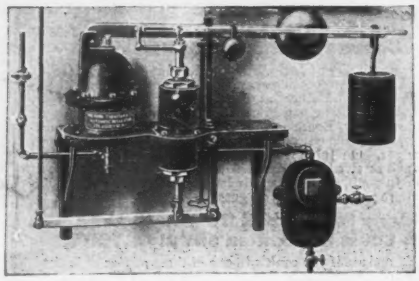

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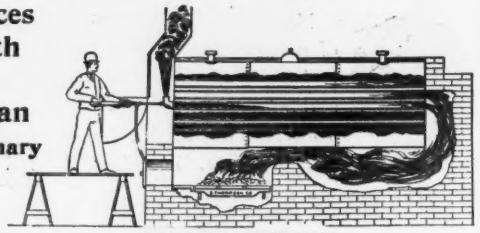

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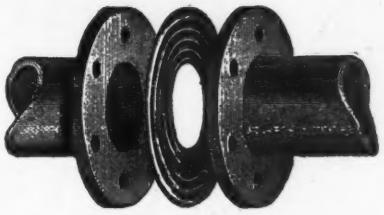

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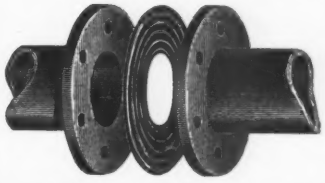

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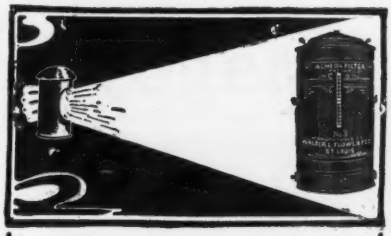

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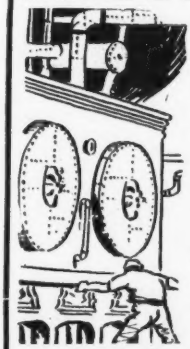

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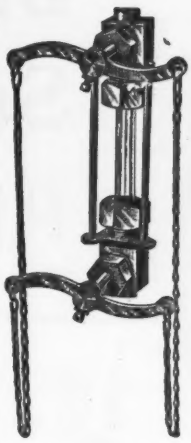

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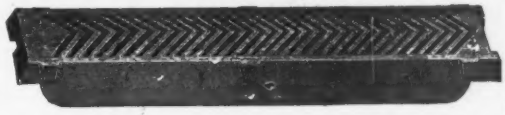

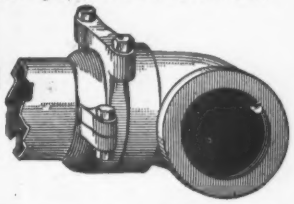

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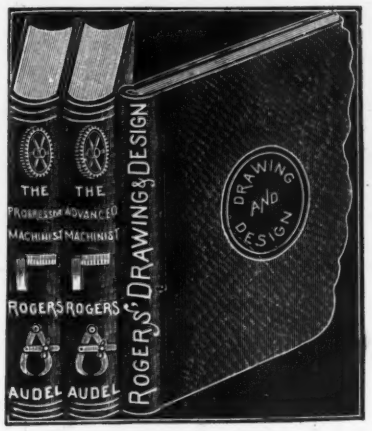

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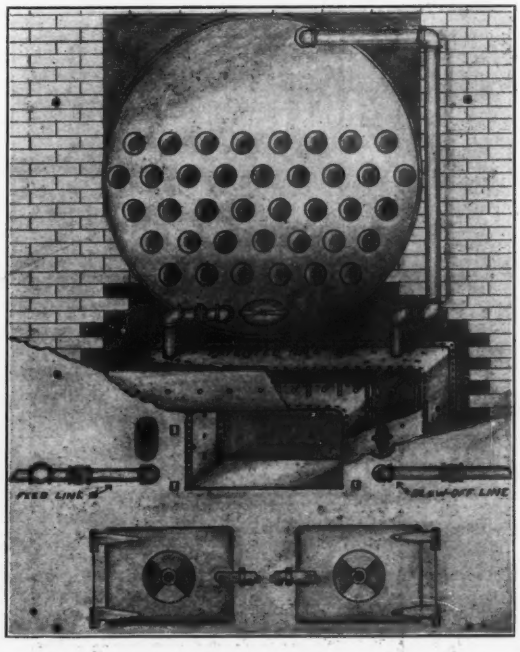

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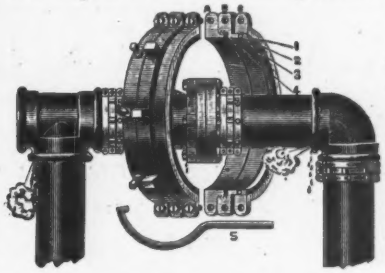

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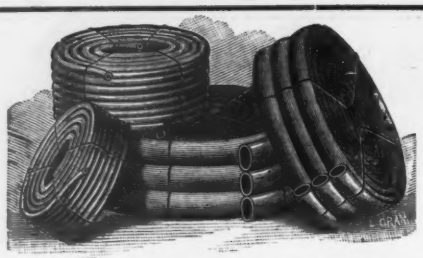

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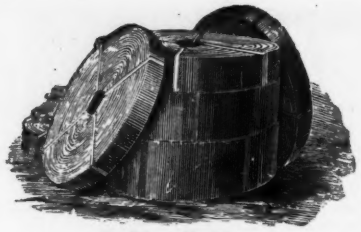
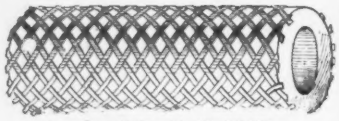
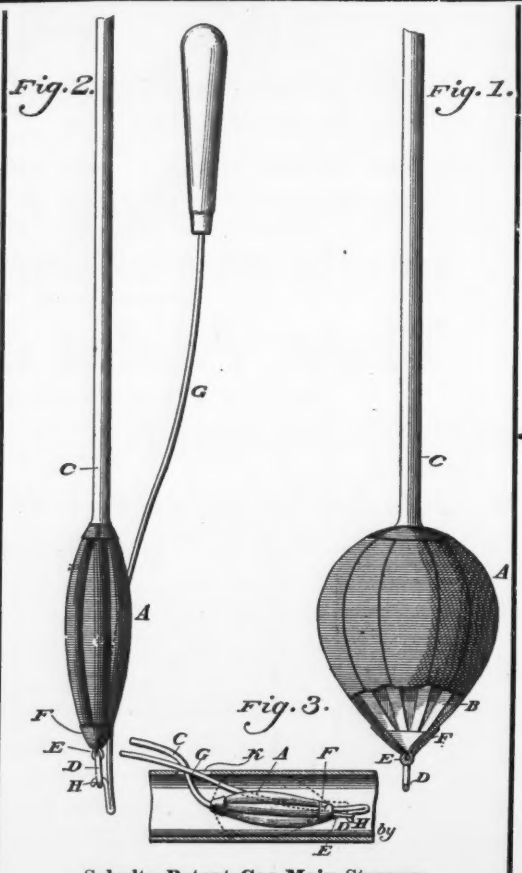
Rubber Valves



Rubber Belting



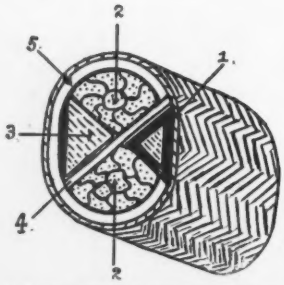
Armored Rock Drill Hose



Schultz Patent Gas Main Stoppers

Linen and Cotton Fire Hose
For Factory and Village Protection

U. S. Patent



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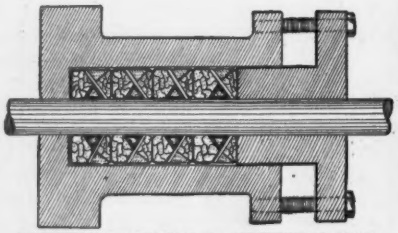

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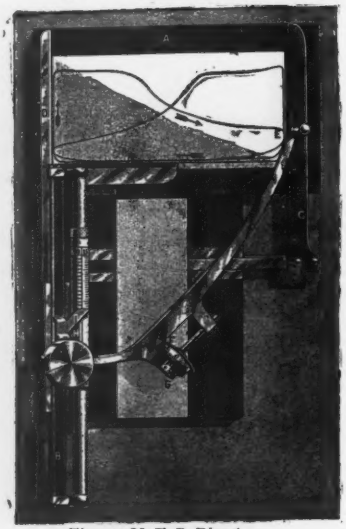

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Bachelder Adjustable Spring Indicator

Complete for any pressure

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CLEANS the tubes without admitting steam into them

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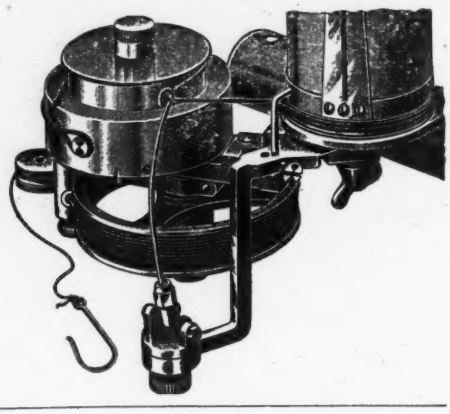
Attached to Bachelder Indicator with Ideal Reducing Wheel

Takes up the slack cord and puts it back where it belongs at the proper time.
No tangling or breaking of cord.



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And Save Rods, Oil, Coal, Friction and the Bosses' Money.

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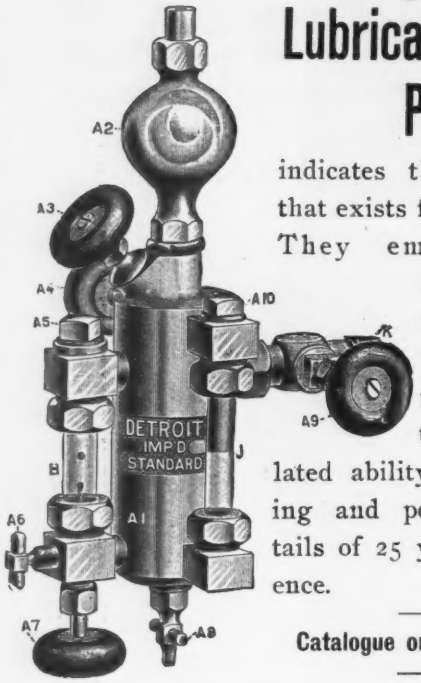
100,000 Detroit Sight Feed Lubricators Per Year



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Catalogue on application.

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READ THIS

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MANUFACTURER OF COMMON AND STOCK BRICK
Orders by rail and river shipped promptly.

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Gentlemen:—I herein hand you P. O. order for $11.70, as per your invoice of Oct. 8th. Your Belt Dressing is A No. 1 for brick making machinery belts, where we have nothing but dirt and dust to work "all the time."
I am more than pleased with it.
Resp'y yours, C. N. ADAMS.

"A Trial Seldom Fails to Bring a Second Order."

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THE PRACTICAL ENGINEER

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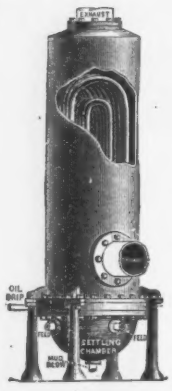
(IMPROVED TO DATE.)

YOU CAN TRY THEM SIXTY DAYS AT OUR EXPENSE.



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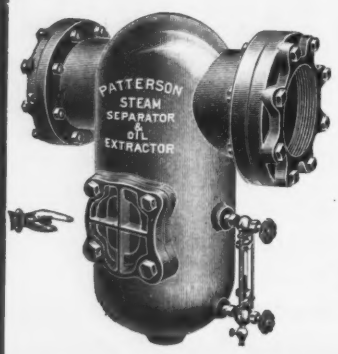
Patterson Berryman Heaters

Because they have so many old friends.

Put on a

Patterson Exhaust Head

and have a clean roof. Get rid of the greasy spray.



Look at that hand hole. Easy to clean a

Patterson Separator or Oil Extractor

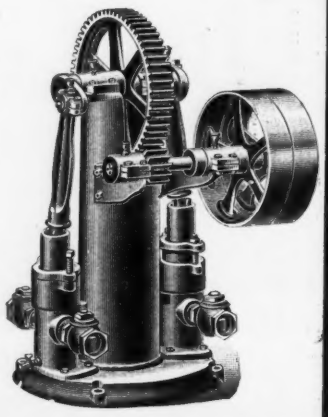
We wish every one appreciated how much cheaper it is to feed a boiler with a belt pump than any other way.

Patterson Pumps

would sell faster than ever.

PLEASE let us know if you are interested. Our proposition is SO reasonable.

WE WANT A FEW MORE GOOD AGENTS.



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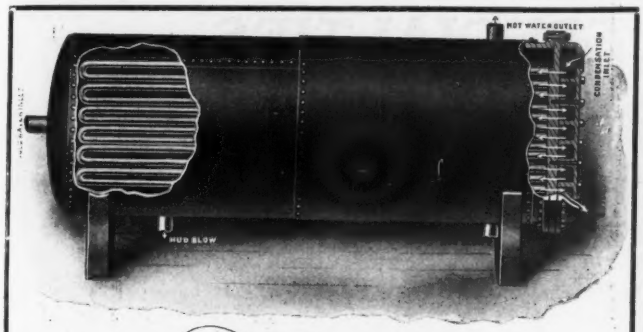
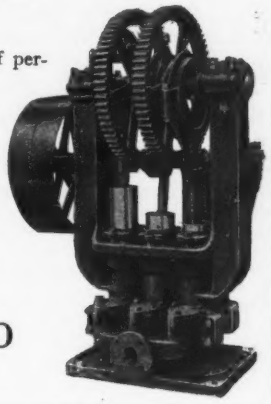


THE CLEANER
TRADE MARK

The **Cleaner** represents the acme of perfection in feed water heating.



The Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.

Manufacturers of
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The OTIS Tubular Feed Water Heater, Oil Separator and Purifier

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

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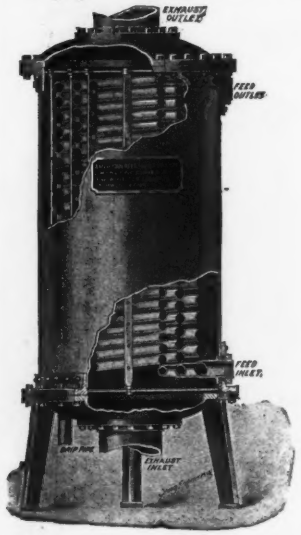
The American Standard Copper Coil Feed Water Heater



Simplicity!
Strength!
Economy!
A Money Saver!

It gives so little trouble that one of our customers, who has used one for 8 years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

That's the kind of a Heater you want.

Write for Catalogue No. 100 P.

The Whitlock Coil Pipe Co.

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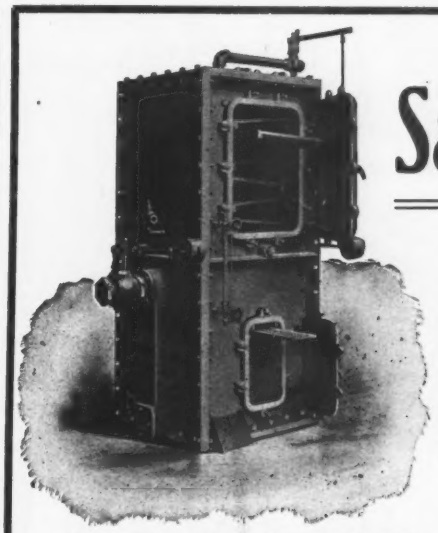

Safety.

Experience proves that "thoroughfare" heaters are subject to serious accidents that cannot happen with

WEBSTER FEED-WATER HEATERS AND PURIFIERS

because Webster Heaters cannot be subjected to excessive pressure through an engineer's mistake in opening or closing valves. Thus they save danger and damage, as well as coal and cost.

Write for booklet.

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WE POINT TO WHAT
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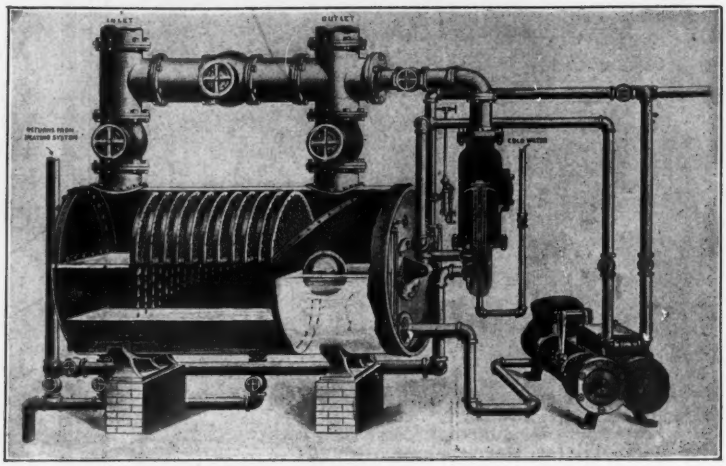
THAT OIL CAN BE ENTIRELY
REMOVED FROM EXHAUST STEAM
AND THAT FEED WATER CAN BE HEATED
ABOUT TO THE TEMPERATURE OF THE EXHAUST

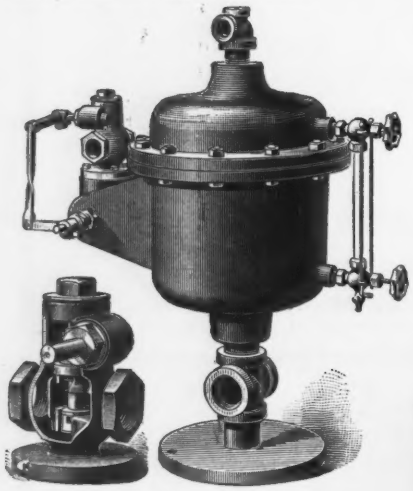
BY

OUR "UTILITY" COMBINATION

We can always guarantee an elimination of 98% at the outlet point of separator. We average over 99% and have in some cases left but $\frac{1}{1000}$ of 1% of oil in the water. You can't see this amount, you can't taste it; fresh well water frequently has more oil in it, and this water can be used for fifty years in boilers without showing a trace of oil deposit. The feed water heating feature is optional but very efficient, free from back pressure and requires but little room and no floor space.

The "Utility" Combination serves as Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater. It costs only about as much as a Feed Water Heater.





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The best Pump Governor on the market. Why? Because our valve will not leak or stick, we guarantee it to absolutely govern the pump and remain tight for five years. Compare the construction of our valve with any other on the market. By adopting the "Utility" you can save coal and get a higher temperature from your heating or drying systems. Send for catalogue and list of users.

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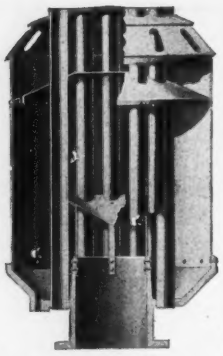
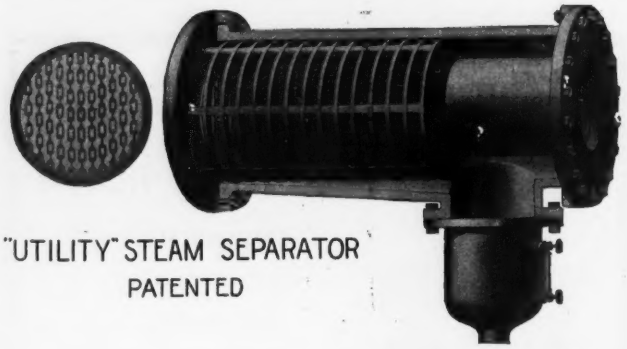
of the chain baffle plate principle which has proven so successful in the oil eliminator may be found in our

STEAM SEPARATOR

and the efficiency of it is very high. Absolutely dry steam, absolutely no back pressure. What more could you ask?



UTILITY EXHAUST HEAD
PATENTED



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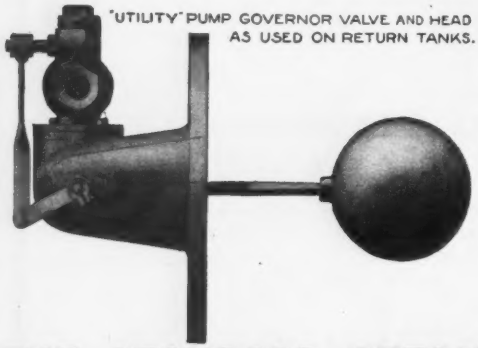
ANOTHER WATER SAVER

is our new Exhaust Head. Notice the great radiating surface that is given by the CIRCULATING AIR TUBES. These act as condensers, and they lessen instead of causing back pressure. Do you realize that a thousand gallons of water are wasted in a moderate sized plant which lacks an efficient exhaust head? It's so



"UTILITY" PUMP GOVERNOR VALVE AND HEAD AS USED ON RETURN TANKS.

WE ALSO CARRY IN STOCK

- **Back Pressure Valves**
- **Blow-off Cocks**
- **Pressure Reducing Valves**
- **High and Low Pressure Boiler Feeders**
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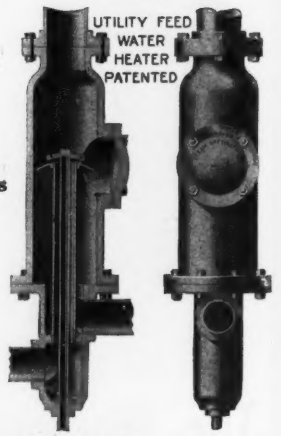
- **Damper Regulators**
- **Feed Water Controllers**
- **"Utility" Beam Clamps**



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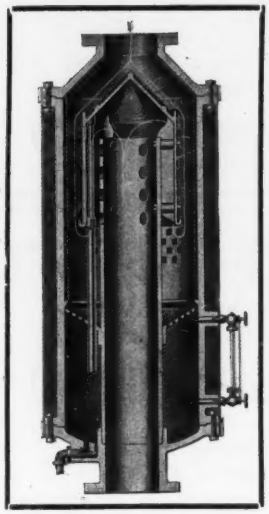

Our steam separators deliver steam containing less than ½ of 1% of water.

Our oil separators remove 99% of the oil.

We can prove they do it and give good reasons why.

In addition they have *size* and are *machines.*

Made all styles, also make **Exhaust Heads** and **Steam Traps.**

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THE BAUM SEPARATOR
For Live and Exhaust Steam

Horizontal Style for Live Steam or Oil Service

RESULTS GUARANTEED

For condensing systems use the BAUM VACUUM STYLE OIL EXTRACTOR.

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WATER-TUBE AND STEAM-TUBE
Cast Iron or Steel Shells. "∩" Shaped Seamless Drawn Brass Tubes

WE BUILD HEATERS FOR EVERY PURPOSE AND CONDITION

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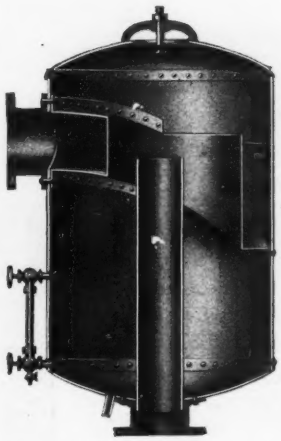
THAT BY USING A WELL DESIGNED AND PROPORTIONED STEAM RECEIVER AND SEPARATOR

YOU COULD



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OVERCOME entirely any chances of damage to your Engine by water throwing over with the steam.
SECURE better cylinder lubrication with less oil.
OVERCOME entirely all steam pipe vibration.
SECURE approximately boiler pressure in engine cylinder.
INCREASE engine power by securing these advantages.
At the same time NOT INTERFERE WITH THE FREE FLOW OF STEAM FROM THE BOILER.

The above advantages can be secured ONLY when

"THE SIMONDS"
IMPROVED
Steam Receiver and Separator

IS USED, as each is proportioned and built for the exact conditions under which it is to operate.

LET ME SEND YOU MY FOLDER THAT TELLS SEVERAL THINGS.

421 Houseman Bldg. **FRANK A. SIMONDS,** Grand Rapids, Mich.

France's Split Case
An Absolute Steam Stopper

"Steam Stopper"
BRAND
Packings

High Pressure Ring Packings
Sheet Rubber Packings
"Black Raven" Asbestos Packing
"France's Special," "France's Regular"
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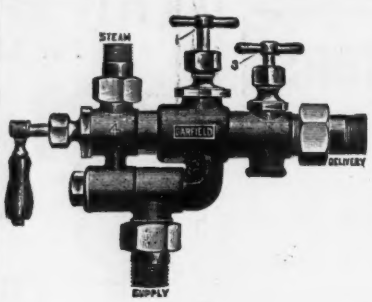

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Equipped with Garfield, Double Jet Injectors and Chicago Sight Feed Lubricators are as satisfactory to the owner as to the engineer.

Boilers steam easily and engines run smoothly.

Send for catalogue and mention THE PRACTICAL ENGINEER.

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if not properly done, in any plant, will cause the engineer a great deal of trouble, and his employer unnecessary expense. Many years of practical experience and a force of competent assistants enables me to guarantee absolute satisfaction.

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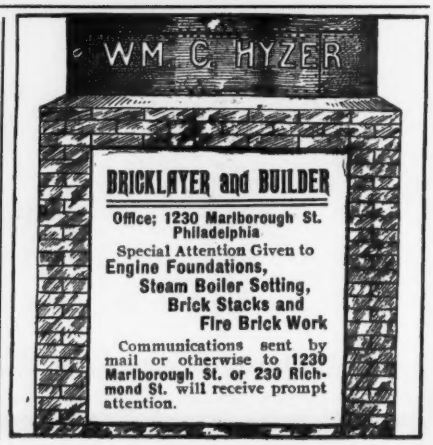
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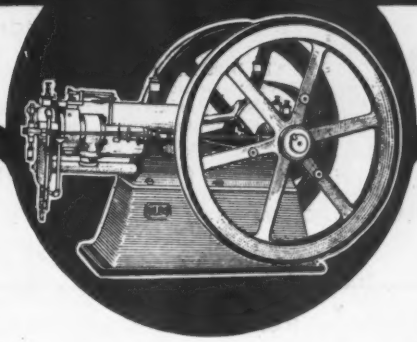

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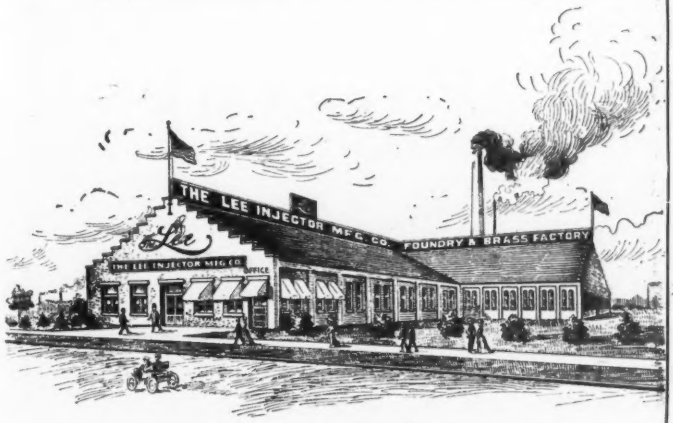

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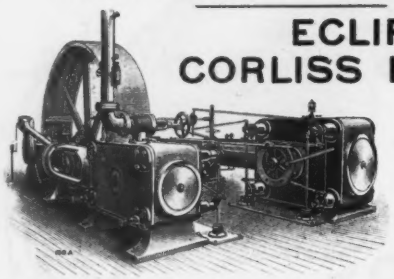

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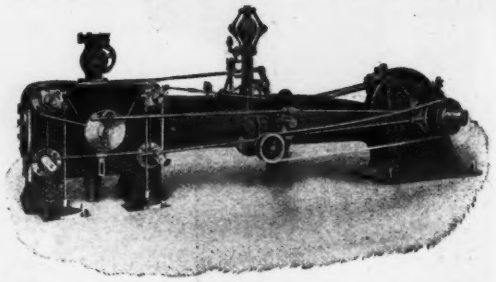

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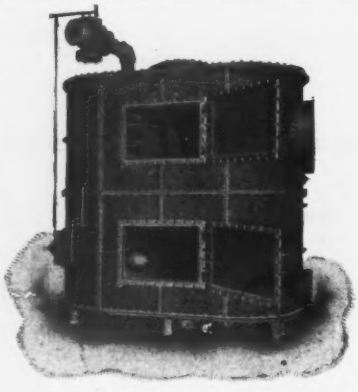

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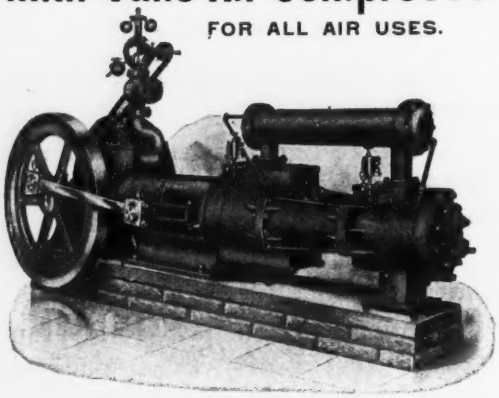

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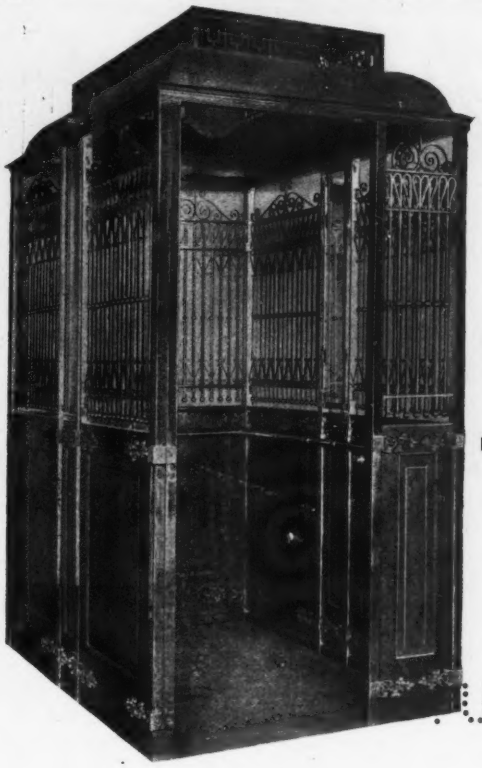

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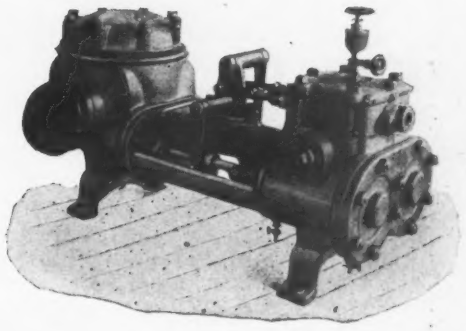

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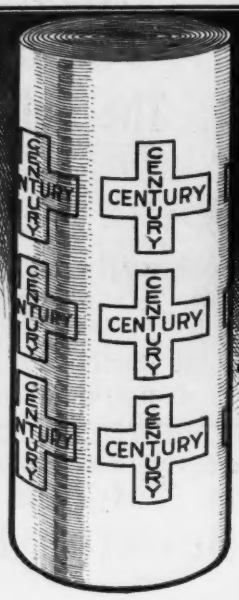

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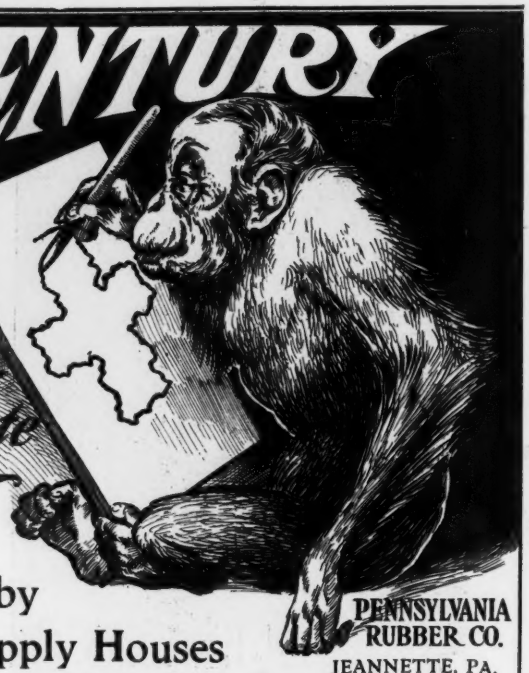

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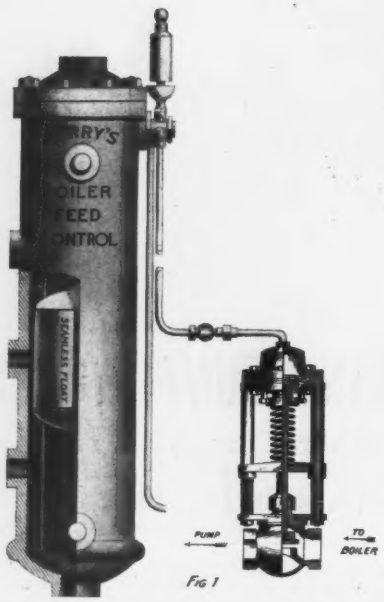

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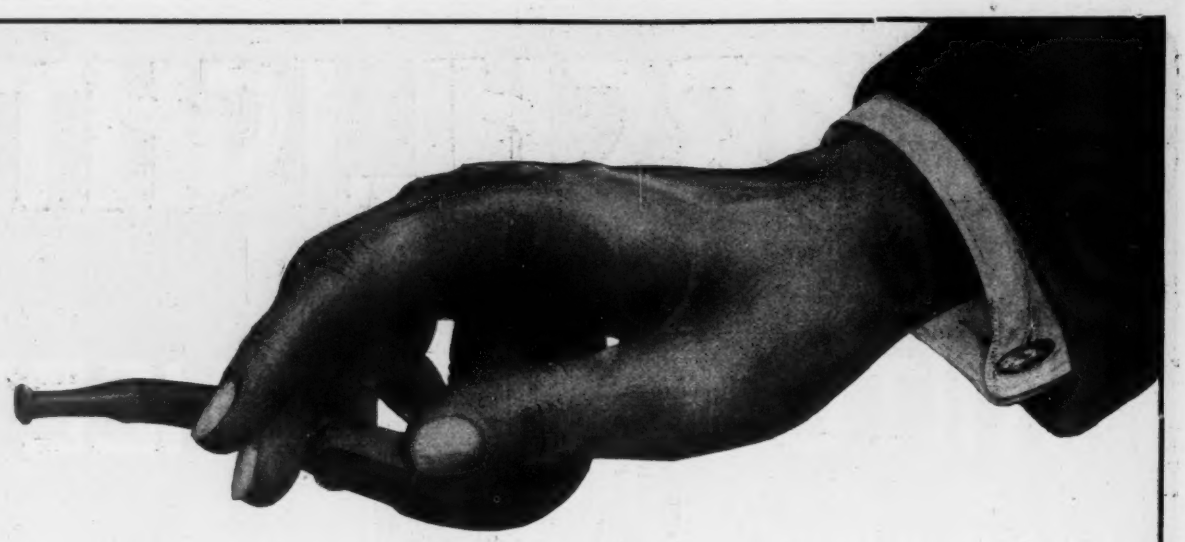

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